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1887/88

ANNUAL REPORT

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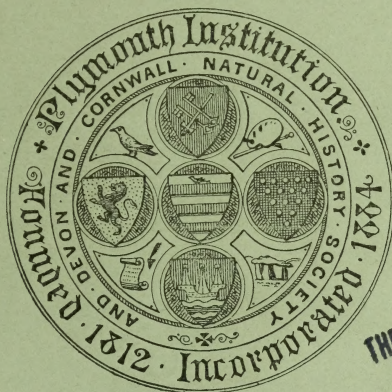
TRANSACTIONS

OF THE

PLYMOUTH INSTITUTION

AND

Devon & Cornwall Natural History Society.



VOL. X. PART I. 1887-88.

PLYMOUTH:

W. BRENDON AND SON, GEORGE STREET.

1888.

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ANNUAL REPORT
AND
TRANSACTIONS
OF THE
PLYMOUTH INSTITUTION
AND
Devon and Cornwall Natural History Society.

1887-88.

OFFICERS OF THE INSTITUTION.

SESSION 1887-88.

President:

MR. F. H. BALKWILL, L.D.S.

Vice-Presidents:

REV. PROF. CHAPMAN, LL.D.

MR. W. GAGE TWEEDY, B.A.

MR. T. HARPER, M.R.C.S.

MR. R. N. WORTH, F.G.S.

Treasurers:

MR. S. CATER.

MR. E. G. BENNETT.

Secretaries:

MR. J. C. INGLIS, C.E.

MR. H. PENROSE PRANCE.

Members of Council:

DR. A. H. BAMPTON.

MR. P. MITCHELL, R.I.

MR. F. BRENT, F.S.A.

DR. R. OXLAND, F.C.S.

MR. R. BURNARD.

MR. J. BROOKING ROWE, F.S.A., F.L.S.

MR. D. D. DOBELL.

MR. D. SLATER, M.A.

DR. J. MERRIFIELD, F.R.A.S.,

MR. F. J. WEBB, F.G.S.

F.R.M.S.

The above form the Council.

Curators:

Library—MR. J. BROOKING ROWE, F.S.A., F.L.S.

Building—MR. J. C. INGLIS, C.E.

Fine Arts—MR. P. MITCHELL, R.I.

Museum Curators:

Anthropology—MR. F. BRENT, F.S.A.

Mammals—MR. F. H. BALKWILL, L.D.S. *Birds*—MR. H. M. EVANS.

Fishes—MR. W. GAGE TWEEDY, B.A.

Invertebrates— { MR. G. BIGNELL, F.E.S. MR. F. BRENT, F.S.A.
 { MR. W. HEAPE, M.A.

Botany—MR. D. D. DOBELL.

Mineralogy—DR. R. OXLAND, F.C.S. *Geology*—MR. F. J. WEBB, F.G.S.

Petrology—MR. R. N. WORTH, F.G.S.



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LIST OF MEMBERS.

HONORARY MEMBERS.

Elected.	Name.	Address.
1865	Adams, J. C., D.C.L., F.R.A.S.	The Observatory, Cambridge.
1877	Beal, Rev. Professor, B.A., M.R.A.S.	Wark Rectory, Hexham.
1887	Dallinger, Rev. W. H., LL.D., F.R.S., etc.	Wesley College, Sheffield.
1874	Froude, James Anthony, M.A.	5, Onslow Gardens, London, W.
1859	Gibbs, F. W., Q.C., C.B., 24, Mount Street,	Grosvenor Square, London, W.
1877	Günther, Dr. A., F.R.S., F.L.S., F.Z.S.	British Museum, London.
1887	Lankester, Ray, Professor, F.R.S.	North Bank, London, N.W.
1865	Lubbock, Sir John, Bart., D.C.L., F.R.S., F.L.S.,	High Elms, Kent.
1874	Pengelly, W., F.R.S., F.G.S.	Lamorna, Torquay.
1859	Scrivener, Rev. F. H. A., M.A., LL.D.	Hendon, Middlesex.
1875	Temple, Right Rev. Dr., Bishop of London,	The Palace, Fulham.
1865	Vivian, Edward, M.A.	Torquay.
1872	Weymouth, R. F., D.LIT.	33, Alfred Road, Acton, London.
1872	Worth, R. N., F.G.S.	4, Seaton Road.

LIFE MEMBERS.

1855	Alger, J.	Sydney, Australia.
1863	Alger, W. H.	Widey Court, near Plymouth.
1856	Bartlett, G.	Plymouth.

CORRESPONDING MEMBERS.

1858	Ormerod, G. W., M.A., F.G.S.	Woodway, Teignmouth.
1863	Vicary, W., F.G.S.	Exeter.
1887	Iago, Rev. W., B.A.	Bodmin.

LECTURING MEMBERS.

1868	Adams, W.	Frankfort Street.
1881	Aldridge, Charles, M.D.	Plympton House, Plympton.
1860	Anthony, Rev. Professor, M.A.	13, Woodland Terrace.
1884	Babb, H. R.	21, Portland Square.
1864	Balkwill, Francis Hancock	Princess Square.
1882	Bampton, Augustus H., M.D.	North Devon Place.
1852	Bate, C. Spence, F.R.S.	Mulgrave Place.
1863	Bennett, E. G.	10, Woodland Terrace.
1826	Bennett, J. N.	Windsor Villas.
1884	Bignell, George C., F.E.S.	7, Clarence Place, Stonehouse.
1888	Binns, Rev. W.	Caer Baden Terrace, Plymouth.
1861	Brent, Francis, F.S.A.	6, Tothill Avenue.
1885	Brenton, W. H.	8, Westbury Terrace, North Road.

LECTURING MEMBERS—*continued.*

Elected.	Name.	Address.
1862	Briggs, Thomas Richard Archer, F.L.S.,	Fursdon, Knackersknowle, near Plymouth.
1881	Burnard, Charles F.	Chatsworth Lodge, Compton Park Road.
1886	Burnard, Robert	3, Hillsborough, Mannamead.
1851	Cater, Samuel	North Devon Place.
1876	Chapman, Rev. Professor, LL.D., M.A.	Western College, Tavistock Road.
1888	Clarke, Rev. R. S.	Westwell Street.
1880	Clarke, Sir Edward, Q.C., M.P.,	Huntingdon Lodge, Peckham-rd., London.
1851	Collier, W. F.	Woodtown, Horrabridge.
1876	Collier, Miss Bertha Cycill	Woodtown, Horrabridge.
1876	Collier, Charles Calmady	Woodtown, Horrabridge.
1884	Collier, G. B., M.A.	Woodtown, Horrabridge.
1877	Coney, Rev. Thomas, M.A.	4, Wingfield Villas, Stoke.
1885	Crealock, W. S., R.N.	3, Houndiscombe Place.
1888	Cunningham, J. T., B.A., F.R.S.E.	Marine Biological Laboratory.
1882	Debnam, Alfred R.	10, Higher Portland Place, Stoke.
1884	Dickson, Rev. W., LL.D.	53, Haddington Road, Stoke.
1884	Dobell, Douglas D.	Princess Square.
1880	Edmonds, Robert G.	Mount Drake.
1882	Evans, H. Montague	4, South Devon Place.
1884	Evans, Godfrey	4, Rochester Terrace.
1874	Fouracre, John T.	Chapel Street, Stonehouse.
1875	Fox, Francis E., B.A., F.R.G.S.	Uplands, Tamerton Foliot.
1868	Fox, R. R.	Westbrook, Tamerton.
1851	Harper, T., M.R.C.S.	1, Gibbon Street.
1886	Harvey, T. H.	Cattedown.
1886	Heape, Walter, M.A.	5, Holyrood Place.
1852	Hine, James, F.R.I.B.A.	Mulgrave Place.
1867	Hingston, C. Albert, M.D.	Sussex Terrace.
1875	Hughes, R. H., M.A., M.B., M.R.C.S.	12, Lockyer Street.
1876	Inglis, James C., C.E.	1, Buckland Terrace.
1881	Inskip, Capt. G., R.N., F.R.G.S.	Torrington House, North Road.
1868	Jackson, George, F.R.C.S.	1, St. George's Terrace.
1851	Jago, George	Halwell House, Halwell Street.
1882	Jago, C. S., F.R.G.S.	Cobourg Street.
1888	Matthews, Coryndon, F.E.S.	Erme Wood, Ivybridge, S. Devon.
1885	McCarthy, R. H.	H.M. Customs, Parade.
1874	Merrifield, John, LL.D., F.R.A.S., F.R.M.S.,	7, Hobart Terrace.
1862	Mitchell, Philip, R.I.	Bedford Terrace.
1867	Monkswell, The Right Hon. Lord .	7, Chelsea Embankment, London.
1870	Morley, The Right Hon. the Earl of,	31, Princess Gardens, South Kensington, London, S.W.
1861	Mount Edgcumbe, The Right Hon. the Earl of,	Mount Edgcumbe, Devonport.
1885	Nicolls, Edward	3, Holyrood Terrace.
1884	Norman, John G.	Sea View Terrace.
1851	Oxland, R., PH.D., F.G.S.	Portland Square.
1871	Pearse, W. H., M.D.	1, Alfred Place.
1886	Phillips, Frank, F.R.C.I.	7, West Hoe Terrace.
1880	Power, W.	H.M. Customs, Parade.

LECTURING MEMBERS—*continued.*

Elected.	Name.	Address.
1883	Prance, H. Penrose . . .	7, Athenæum Terrace.
1859	Prowse, A. P. . . .	Yannadon, Horrabridge.
1884	Radford, Charles H. . . .	37, Bedford Street.
1880	Rew, G. Gale	3, Whitefield Terrace.
1884	Rice, J.	21, Walker Terrace.
1875	Rider, A., F.C.S. . . .	4, Haddington Road, Stoke.
1888	Ridge, B. J.	3, Gainsborough Place, Mutley.
1857	Risk, Rev. J. Erskine, M.A. . .	Princess Square.
1861	Rowe, J. Brooking, F.S.A., F.L.S. .	Plympton.
1886	Sexton, Louis	Portland Square.
1860	Shelly, John	Princess Square.
1875	Smith, Robert	George Street.
1867	Slater, D., M.A., ...	Cheveley Hall, Seymour Road.
1886	Slater, Gilbert, B.A. . . .	Cheveley Hall, Seymour Road.
1869	Square, W., F.R.C.S., F.R.G.S. .	Portland Square.
1883	Square, William Joseph, F.R.C.S. .	Portland Square.
1884	Square, J. Elliott, F.R.C.S. . .	Portland Square.
1865	Tweedy, W. Gage, B.A. . . .	Athenæum Terrace.
1884	Vincent, Rev. Samuel	6, Woodland Terrace.
1885	Wade, William Cecil	5, Portland Square.
1883	Watson, G. F.	3, Walker Terrace.
1875	Webb, F. J., F.G.S. . . .	13, Portland Villas.
1864	Weekes, Samuel, MUS. BAC. . .	Sussex Terrace.
1888	Weldon, W. F. R.	3, Windsor Terrace, Plymouth.
1887	Wilson, W. C., M.B.	St. Aubyn Street, Devonport.
1888	Wood, Carslake W.	Hareston, The Crescent, Plymouth.
1888	Wood, J. Winter	Hareston, The Crescent, Plymouth.
1873	Woolcombe, R. W., Surgeon-Major .	St. Jean D'Acre Terrace, Stoke.
1879	Worth, R. N., F.G.S. . . .	4, Seaton Road.
1878	Wright, W. H. K., F.R.H.S. . .	31, Headlands Park.
1885	Wyatt, R. C., B.A.	Clifton House Grammar School.

"The property of the Institution, the election of members, management of the concerns, and enactment of laws, are vested exclusively in the Lecturing Members."—LAW 5.

ASSOCIATES.

Adams, Benjamin, Walmer Villa.	Bulteel, Hillersden, Radford, Plymouth.
Allen, Mrs. E. R., 11, Coryton Terrace, Plymouth.	Butler, Theobald, M.A., Wellington Villa, Mannamead.
Barrett, G. R., Bank of England Place.	Chalker, John P., 9, Crescent Place.
Barrett, J., 4, Seymour Terrace.	Clark, W., 19, Portland Villas.
Barron, J., 16, Townsend Crescent, Compton Giffard.	Coath, J., 7, Holyrood Place.
Bayly, John, Seven Trees.	Cole, A., Bedford Terrace.
Bayly, Robert, Torr Grove, Plymouth.	Collins, George, 4, Windsor Terrace, Plymouth.
Beechey, Admiral, 13, St. James's Terrace.	Compton, C. E., 5, St. James's Terrace.
Berry, J. P., 2, Walker Terrace.	Cooper, Cornelius Francis, 17, East Street, Plymouth.
Brendon, W. Turner, George Street.	Cuming, Dr. C. H., Sussex Street.
Brown, J. P., The Abbey, Plymouth.	Daubeney, Major G. A., Brent.
Browning, F., Compton House, Compton.	Derry, W., Houndiscombe House.
Bulteel, Thomas, Radford, Plymouth.	Deutsch, Herr, 3, Hoe Park Place.

ASSOCIATES—*continued.*

- Diment, Thomas, 8, Brunswick Terrace.
 Dingle, Thomas, sen., 2, Channel View, Lipson Road.
 Edgcombe, F. H., 17, Kensington Terrace.
 Fell, Thomas, 23, Princess Square.
 Fisher, C., 1, Victoria Place, Stonehouse.
 Foale, William, jun., 3, Meadsfoot Terrace, Mannamead.
 Foster, J. B., 4, Cambridge Street.
 Greenlaw, Wm., 3, Glenside, Manna-mead.
 Hambly, Alfred G., 8, Sussex Terrace.
 Harris, Henry Vigurs, Union Street.
 Hearder, H. P., Westwell Street.
 Heath, William, George Street.
 Hill, F. N., 9, South Devon Place.
 Honey, Augustine, Frankfort Street.
 Hoppen, Vosper, George Street.
 Hoskin, R., Ebrington Street, Plymouth.
 Hubbard, G., J.P., Ford Park.
 Jago-Trelawny, Major-Gen., Col-drenick, Cornwall.
 Jago, Richard, Halwell House, Halwell Street.
 James, Capt., R. W. Yacht Club.
 James, C. H., Ingleside, Mannamead.
 James, Edward, J.P., Greenbank.
 Jasper, Thomas, 2, Melville Place, Ford.
 Jenkins, Sir James, K.C.B., R.N., Nevinston, Seymour Road, Compton Gifford, Plymouth.
 Kerswell, Alfred J., Ham Street.
 Kerswell, Samuel, 1, Osborne Place.
 Kerswill, F. J., Frankfort Street.
 King, William, Hoe House.
 Lampen, Major-Gen., J., 6, Alton Terrace.
 Latimer, Alfred, Portland Square.
 Lemann, Fred. C., Blackfriars House.
 Lemon, Rev. T. W., M.A., 1, Cheltenham Place.
 Lovibond, J., H.M. Customs, Parade.
 Mabin, Francis, 10, Union Street.
 Martin, W., Windsor Villas.
 MacAndrew, J., F.L.S., Lukesland, Ivybridge.
 Mitchell, T., Eton Villas.
 Morrish, F. A., 2, Bedford Terrace.
 Morris, Charles, Gascoyne House.
 Mugford, James A., Elm Villa, Mannamead.
 Nicoll, G. B., 11, Laira Terrace, Plymouth.
 Norbury, Dr. H. F., R.N., C.B., 40, Torrington Place.
 Page, James A., 10, Windsor Terrace.
 Pagen, J. Fletcher, F.G.S., Pendower, Mannamead.
 Pearse, S., Royal Hotel.
 Pearse, T., M.D., Flora Place.
 Penrose, Richard A., 74, Durnford Street, Stonehouse.
 Penrose, W. A., Victoria Chambers, Plymouth.
 Penson, James, 7, Boon's Place.
 Philips, G., 1, Victoria Place, Stonehouse.
 Pode, J. Duke, J.P., Slade Hall, Ivy-bridge.
 Preston, H., 3, Bedford Place.
 Radford, John, Bedford Street.
 Randle, J., Union Street.
 Reed, W. R., General Post Office, Plymouth.
 Revelstoke, Lord, Membland.
 Rodd, R. R., jun., 63, Union Street, Stonehouse.
 Rooke, Samuel, 5, Westbury Terrace.
 Rorie, John, M.D., Ford Park.
 Roy, David, 6, Holyrood Place.
 Russell, G., Hoe Park House.
 Serpell, E. W., 19, Hill Park Crescent.
 Smith, E. S., Old Town Street.
 Stephenson, G., Old Town Street.
 Stephenson, R., National and Provincial Bank of England, Devonport.
 St. Germans, The Right Hon. the Earl of, St. Germans, Cornwall.
 Stribley, Edw., 3, Kobe Terrace.
 Taylor, Frank, 37, Flora Street.
 Taylor, J., 37, Flora Street.
 Taylor, Sydney, 37, Flora Street.
 Trehane, J. H., Princess Square.
 Trelawny, Sir W., Bart., Trelawne.
 Underhay, Mrs. H., Billacombe, near Plymouth.
 Williams, H. J., Polperro, Cornwall.
 Willoughby, J., Stafford Terrace.
 Willoughby, W., The Foundry, Plymouth.
 Wills, J. C., 68, Durnford Street, Stonehouse.
 Wilson, J. Walter, 10, Leigham Villas.
 Windeatt, John, Woodland House.
 Wing, F. W., Lisson Grove, Plymouth.
 Woodhouse, Henri B. S., 10, Portland Square.
 Woolcombe, J. Y., Princess Square.
 Yerbury, Major J. W., Mount Wise, Devonport.

LADY ASSOCIATES.

Borland, Mrs. R., Emma Place, Stonehouse.	Gidley, Miss, 2, St. Michael's Terrace.
Cann, Miss Agnes, 20, Tavistock Road.	Keen, Miss, 1, St. James's Terrace.
Cooper, Miss Agnes G., 12, Chelten- ham Place.	Keen, Miss E., 1, St. James's Terrace.
Creagh, Mrs. H. W., 4, Victoria Place, Stonehouse.	Minhinnick, Miss E. M., Portland Square.
	Waghorn, Miss, 1, Seaton Terrace.

JUNIOR ASSOCIATES.

Crowther, J. B., 1, Buckland Terrace. | Worth, R. G. H., 4, Seaton Road.

TO

FOR THE YEAR ENDING 1ST APRIL, 1888.

We have examined the foregoing accounts and balance sheet, and compared the same with the vouchers, and find the same correct.

J. G. NORMAN,
LOUIS E. SEXTON,

April 3rd, 1888.

REPORTS

PRESENTED AT THE ANNUAL MEETING OF MEMBERS,

5TH APRIL, 1888.

THE Secretaries have once more the pleasure of being able to present a satisfactory Report of the working of the Plymouth Institution and Devon and Cornwall Natural History Society.

The proceedings of the Session 1887-88 have not, it is true, been marked by any exceptional features; but the operations of the Society have been carried forward in a very satisfactory manner, and substantial progress in several directions has been made.

The Lectures, on the whole, have been well attended, and some of the discussions were exceptionally animated. As in the previous year, there has been a noteworthy addition to the list of Lecturers, and several of the subjects have been of peculiar interest, an unusual number bearing on topics of a more or less immediately local character.

The programme was as follows:

1887.

Oct.	6.	Conversazione.			
„	13.	President's Address.			
„	20.	The Cattedown Cave	.	.	MR. R. N. WORTH, F.G.S.
„	27.	Plympton	.	.	MR. J. BROOKING ROWE.
Nov.	3.	The Drama	.	.	MR. GREENLAW
„	10.	Thomas à Becket	.	.	MR. F. J. WEBB, F.G.S.
„	17.	The Race and the Nation; or, The Elements of True Nationality	.	.	REV. J. E. RISK, M.A.
„	24.	Some Present-day Evidence for the Ricardo Theory of Rent	.	.	MR. D. D. DOBELL.
Dec.	1.	Discussion: Dartmoor. Introduced by			MR. W. GAGE TWEEDY, B.A.
„	8.	Vittore Pisano, Medallist	.	.	MR. J. SHELLY.
„	15.	Grattan's Parliament	.	.	MR. G. SLATER, B.A.
„	22.	Home Arts and Industries	.	.	MR. J. PHILLIPS.

1888.

Jan. 5.	Conversazione.	
„ 12.	The Ober-Ammergau Passion Play,	
	1880	REV. W. BINNS.
„ 19.	Pre-organic Evolution	REV. PROF. CHAPMAN, LL.D.
„ 26.	Eggs of Fishes and their Develop- ment	{ MR. J. T. CUNNINGHAM, B.A., F.R.S.E.
Feb. 2.	The Herring Fishery	
„ 9.	Observations on Insect Life . .	MR. G. C. BIGNELL, F.E.S.
„ 16.	Irish Revolutionists, their Leaders and Literature. An Historical Sketch	MR. MCCARTHY.
„ 23.	Lake Dwellings	MR. F. BRENT, F.S.A.
Mar. 1.	William Robert Hicks, of Bodmin. A Memoir	MR. W. F. COLLIER.
„ 8.	Early Western Railroads. . . .	MR. R. HANSFORD WORTH.
„ 15.	Dartmoor (discussion continued) .	{ MR. W. G. TWEEDY, B.A. MR. R. N. WORTH, F.G.S.
„ 22.	On the Track of the “Old Men,” Dartmoor—Illustrated . . .	
„ 29.	Recent Geological Work at the Lizard	MR. HOWARD FOX, F.G.S.

There has been a still further increase in the number of Lecturing Members, but the Associates show a falling off; and the Secretaries again beg earnestly to press upon all the friends of the Institution the desirability of doing what they can to increase the numbers of those belonging to the Society, which ought to be more largely supported than it is in so populous a centre, especially when the special character of its objects is considered, and the fact that no similar association exists nearer than Torquay on the one hand, and Truro on the other, while its aims are wider and more inclusive than those of any other scientific or literary organization in Devon or Cornwall.

The Treasurer's report will show that while there has been a slight falling off in the ordinary income of the Society, yet, owing to the fact that there has been no expenditure of an exceptional character, the debt has been reduced to £350 from £383. This, however, still cripples the operations of the Society to such an extent that it is proposed to make an attempt to clear it off, and a committee has been appointed to consider in what way this may best be done.

It is earnestly hoped that the members and friends of the Institution will give hearty aid to this final effort.

There has been an unusually large and valuable series of

presentations to the Library, Museum, and Art Gallery, particulars of which will be found in the Reports of the various Curators. Additional shelves have been fitted in the Library, and new cases provided in the Museum; the latter by the kind aid of some friends, and at no cost to the Institution.

The Anniversary Meeting was held on Monday, May 2nd, when a paper was read by Mr. D. Slater, written by a lady member of the University Lecture Class, on "Rousseau," and remarks made by Mr. R. N. Worth "On Some Ancient Records of Tavistock."

Each half of the Lecture Session was as usual opened by a *Conversazione*. At the first of these the pictures exhibited by the members of the Plymouth Art Club were the main attraction. At the second there was a choice display of sketches by various artists, engravings, &c. Music was kindly provided by Mrs. H. P. Prance, the Misses Risk, and Miss Mitchell.

The Annual Excursion was, by the kind permission of his Grace the Duke of Bedford, to Endsleigh, and was thoroughly enjoyed, the day proving fine, and the arrangements most successful. The party went from Plymouth to Tavistock by train, and then started in waggonettes for Endsleigh, *viâ* Devon Great Consols. Prior to leaving Tavistock, by the courtesy of the vicar, the Rev. D. P. Alford, a visit was paid to the Vicarage grounds, where the interesting remains of the Abbey were inspected, with the three British inscribed stones, placed in the garden by the Rev. E. A. Bray. The church was also visited, where the chained *Paraphrase* of Erasmus and the reputed bones of Ordulf were pointed out.

At Devon Great Consols, reached after a very pleasant drive over the high land commanding the valley of the Tamar, the party was most heartily received by Mr. Moses Bawden, Captain Isaac Richards, and Captain Clemo, and conducted over the surface works. Arrangements had also been made that the man-engine should be in operation for the inspection of the visitors, and this excited much interest.

Endsleigh needs no description from or for true Devonians; and it is only needful to say that the beauties of this charming spot were delightedly enjoyed, and that it was with much regret the party mounted the vehicles again, even though they knew that the high tea, which eventually proved so welcome, was awaiting them at the "Bedford."

There were three short excursions. The first was a botanical excursion, under the direction of Mr. D. D. Dobell, to Old Newnham and Hemerdon. The second was a visit to the "Cattedown Cave," which will be found fully described in our *Transactions* for this year. There was a large party, and the necessary explanations were given by Mr. Worth, F.G.S., and Mr. Robert Burnard; after which Messrs. Burnard, Lack, and Alger had tea hospitably served in their office adjoining. Thanks to the kindness of Mr. G. F. Watson, who kindly lent the yacht-trawler *Lola*, a dredging excursion was also arranged for, and took place in August.

The Honorary Librarian reported as follows :

"During the past year the binding of the volumes of the scientific periodicals has been proceeded with, but the funds of the Institution have not allowed the binding of many books in the Library requiring it.

"The books generally are in good condition. The Library has been much used since the last meeting, and the difficulties referred to in last year's Report as to the circulation of books and their being properly entered have increased, and much anxiety has been caused to your Curator. Of course, what is wanted is a Librarian who would be able to attend daily between certain hours, and that books should be only issued by him. Until such an arrangement can be made, the Society must depend on the good faith and honour of Members and Associates properly entering books removed from the Library.

"The following Regulations have been sanctioned by the Council for the use of the Library, and it is hoped that they will be useful in their working, and beneficial in their results.

1. The Library shall be open daily (except on the days mentioned in Regulation 2) from 10 in the Morning until dusk.
2. The Library shall be closed on all Sundays, Good Friday, Christmas Day, and Bank Holidays; on Wednesday afternoon in every week from 2 o'clock; and on such other days as shall be directed by the Council; as well as from the 20th March to 1st April, as provided by Law 38.
3. Every Member or Associate may borrow from the Library any number of printed circulating Books not exceeding four, and may exchange any of the borrowed volumes for others as often as he pleases, but so that he shall not have more than four volumes in his possession at any one time.

4. No Book borrowed from the Library shall be retained for a longer period than twenty-one days, if the same be applied for by any other Member or Associate, nor in any case shall any Book be retained for a longer period than three months.
5. Every Member or Associate who shall borrow any Book shall be responsible to the Society for its safety and good condition from the time of its leaving the Library until it shall be returned, and in case of loss or damage he shall replace the same or make it good, or if so required by the Council, shall furnish another copy of the entire set of which it may be a part.
6. The Council, or the Curator of the Library between its meetings, shall decide what works shall not go out of the Library, either on account of their value or on account of their being works of reference.
7. No book shall be issued to any person not being a Member or Associate, without a special order of the Council.
8. Every application by any Member or Associate, who shall not attend in person, for the loan of any book or books, shall be in writing, and be presented to the Curator of the Library or the Housekeeper by an authorised agent therein named.
9. The title of the book borrowed shall be entered in the book provided for the purpose, and such entry shall be signed by the borrower or his agent, and the return of books borrowed shall be duly entered in the same book. The borrower shall also fill up a ticket in the form provided, and sign the same and hand it to the Housekeeper on leaving the Library, and the Housekeeper is required to demand such ticket.
10. The Council for good cause shown shall have power to relax or suspend any of these Rules or Regulations in the case of any Member or Associate requiring books in connection with any matter of special research in which he may be engaged.
11. These Rules and Regulations shall be taken and read in connection with Laws 34 to 39, heading "LIBRARY."

During the past twelve months the following have been presented to the Institution :

"By Societies—'Journal of the Royal Microscopical Society,' 1887-88. 'Proceedings of the Zoological Society,' 1887-88. 'Quarterly Journal of the Geological Society of London,' Nos. 170 to 173. 'Proceedings Geologists' Association,' 1886-87. 'Proceedings Royal Society of London,' Nos. 253-263. 'Journal Royal Geological Society of Ireland,' vol. viii. part 2. 'Report British Association,' 1886-87. 'Memoirs Manchester Literary and Philosophical Society,' vol. x., 1887. 'Proceedings Manchester Literary and Philosophical Society,' 1885-86, 1886-87. 'Transactions Botanical Society, Edinburgh,' parts of vols. xvi. and xvii. Bulletins au Comité Géologique, St. Petersburg, parts of vol.

vi. 1887. 'Report Belfast Naturalists' Field Club,' vol. ii. part 6. 'Essex Naturalist,' 1887-88. 'Journal British Archæological Society of Rome,' parts 1-3. 'Atti della Societe Toscana,' 1887. 'Journal Royal Geological Society, Cornwall,' vol. xi. part 1. 'Proceedings Natural History Society of Glasgow,' 1885-86. 'Proceedings Manchester Microscopical Society,' 1886. 'Proceedings Natural History Society, Northumberland, Durham,' &c., vol. ix. part 1. 'Proceedings Royal Dublin Society,' 1886-87. 'Report Manchester Scientific Students' Association,' 1885-86. 'Report Penzance Natural History Society,' 1886-87. Transactions 'Somersetshire Archæological and Natural History Society,' 1886. 'Report Royal Cornwall Polytechnic Society,' 1886. 'Proceedings Bristol Naturalists' Society,' vol. v. part 2. 'Transactions Devonshire Association,' vol. xix., 1887. 'Devonshire Domesday,' part 4. 'Journal Royal Institution of Cornwall,' 1887. 'Journal Royal Society, New South Wales,' 1886. 'Journal Marine Biological Association,' 1887. 'Transactions Yorkshire Naturalists' Union,' parts 1-9. 'Transactions New York Academy of Sciences,' 1885-86; 'Smithsonian Report,' 1884-85; 'Transactions New York Academy of Sciences,' 1884-85, by the Smithsonian Institution. 'Geological History of Lake Lahoutan,' 'Mineral Resources of the United States,' 1885-86; 'Monograph No. 10, Dinocerata,' O. C. Marsh; 'Bulletin of Survey,' 34-39; 'Sixth United States Geological Survey Report,'—by the Directors of the United States Geological Survey. 'Natural History of Victoria, Prodromus of Zoology,' Decades 1-15, by the Government of Victoria. 'Catalogue of Canadian Plants,' part 3, by the Geological and Natural History Survey, Canada. 'Earth History of the Remote Past,' 1886; 'Hippopotamus from Carrington,' 1885; 'On the Geology of Anglesea,' No. 2, 1882; 'On some Perched Blocks and Associated Phenomena,' 1886; 'Notes on the Geology of the Vale of Clwd,' 1884;—by the Woodwardian Museum, Cambridge. 'Annual Report of Department of Mines,' 1886; 'Geology Vegetable Creek Tin Mining Field,'—by the Government of New South Wales. 'Proceedings Royal Geographical Society,' 1887-88, by Mr. W. Square. 'First Report of Free Stæchiological Dispensary for Consumption,' Dr. J. F. Churchill, by the Author. 'Tourist's Guides to Dorsetshire,' 'Somersetshire,' 'Wiltshire,' 'South Devon,' and 'North Devon,' by Mr. R. N. Worth, by the Author. 'Calendar of Tavistock Parish Records,' by

Mr. R. N. Worth, by His Grace the Duke of Bedford through the Author. 'A Literal Translation of Cynewulf's *Elena*, by Dr. R. F. Weymouth. 'Report of Commissioners on Defences of United Kingdom,' 1860; 'Gibbon's Decline and Fall of the Roman Empire;' 'Principles of Botany, Willdenow,' 1811; 'Lindley's British Flora,' 1835; 'Accum's Practical Essay on Chemical Re-agents,' 1816; 'Cours d'Agriculture,' 3 vols., 1782; by Mr. Francis Brent, F.S.A. 'Spallanzani's Tracts on Natural History,' 2 vols.; 'Spallanzani's Travels in The Two Sicilies,' 4 vols.; 'Spallanzani's Experiments upon the Circulation of the Blood;' 'Lawrence's Comparative Anatomy,' 1807; 'Brisson's Ornithologia,' 2 vols., 1763; 'Cuvier's Anatomie Comparee,' 5 vols., 1805; 'St. Hilaire's Histoire des Mammiferes,' 1834; 'Blainville's De l'Organisation des Animaux,' 1822; by Mr. J. Brooking Rowe. 'Shapter's Climate of the South of Devon,' by Mr. J. C. Inglis. Supplement to the paper 'On the Causes and Results of Assumed Cycloidal Rotation in Arterial Red Discs,' by Surgeon-Major R. W. Woolcombe, 8vo., 1886. 'Further Supplementary Remarks on Supposed Cycloidal Rotation of Arterial Red Discs,' by Surgeon-Major R. W. Woolcombe, 8vo., 1887;—both reprinted from the Reports of the British Association, by the Author.

"The following works have been purchased: 'Zoological Record,' 1886. 'Ray Society; Michael's British Oribitidæ.' 'Fauna and Flora of the Gulf of Naples,' No. 14. 'Report of the *Challenger* Exploration; Zoology, vols. xvii. to xxi.; Botany, vol. ii. 'Publications Early English Text Society;' ordinary and extra series, 12 parts. 'The Structure and Life History of the Cockroach,' by Miall and Denny, 1886. 'British Insects,' Staveland, 1871. 'Publications Folk Lore Society.' 'Coleoptera of the British Islands.' 'Publications of the Palæontographical Society.'

"The following periodical Works have been continued: 'Nature,' 'The Zoologist,' 'Geological Magazine,' 'Entomologist,' 'Journal of Botany,' 'Philosophical Magazine,' 'Entomologist's Monthly Magazine,' 'Annals and Magazine of Natural History,' 'American Journal of Science,' 'Western Antiquary,' 'Mind,' 'Ibis,' 'Grevillæ,' 'Quarterly Journal of Microscopical Science,' 'Journal of Anatomy and Physiology,' 'Annals of Botany.'

the premises belonging to the Society were in a satisfactory state of repair, and had been so maintained during the past year. The work of maintenance and improvement during this period comprised: The heightening of the shelves, and affording increased accommodation for books, in the Library; the providing and fixing of a new stove for the Housekeeper; one new table-case added to the Museum; the laying in of a new pipe drain from the building to the main sewer, and the necessary traps to prevent sewer gas getting into the building; sundry repairs to the glass skylights, and the stoppage of leaks therein.

The Curator of Fine Arts reported that the interesting series of fine engravings of Old Plymouth, the property of the Institution, had been cleaned and placed in the Art Gallery.

“Mr. Edward Opie, an artist of the highest reputation, has given an excellent portrait of Sir Joshua Reynolds, which he himself copied from the original, exhibited at the British Institution some years ago. This is given in exchange for the one formerly hung in the Hall, which had quite gone to decay.

“Mr. Robert Burnard has presented to the Institution a set of autotype reproductions of old sixteenth-century engravings, illustrative of the Spanish Armada. They are very well framed and set up, and, coming in this tercentenary year of the great invasion, are a very acceptable gift to our Society.

“A portrait of the late Dr. Hearder has been offered to the Institution by his son, Mr. William Hearder. The picture is an excellent likeness by an artist named Williams.”

The Curator of Anthropology, &c., reported:

“The collections in my charge are in good order. They are mostly arranged in their respective cases, or upon the walls of the Museum. Some of the objects have created much interest amongst the numerous visitors who have inspected the Museum during the year. Several presentations have been made, some of which are of importance. Amongst these may be mentioned:

“A fine stone celt. found at Houndiscombe, and portions of a large ancient British urn from a barrow near the Cheesewring, by Mr. R. N. Worth, F.G.S. Many specimens of manipulated flints from localities in Devon and Cornwall; a bronze coin of John V. of Portugal, found in excavations at the Citadel; model of canoe, Vancouver's Island; Moorish tiles and pottery from

Tlemçen, Algeria—by your Curator. A silver circular plate, stamped in imitation of engraving, showing the course taken by Sir Francis Drake in his voyage round the world in 1577–1580, reproduced from the original in the British Museum, by Mr. Robert Burnard. A curious Chinese book, block-printed, representing street scenes, taken at the capture, by assault, of Nam-tow, Canton river, in 1858, by Colonel T. V. Cooke, R.M.L.I. A small Roman bronze coin (Constans?), dug out of the soil near the Kitchen Midden, Batten, by Mr. Cecil Brent, F.S.A., and presented by him.

“A fine collection of arms, implements, and ornaments of the Dyaks, Sarawak, Borneo, has been deposited in the Museum, on loan for ten years at least, by Mr. C. S. Pearse, of Thornham, Ivybridge, of the Rajah’s Service.

“Your Curator hopes that, if these presentations are made known, others may be made by gentlemen and others in the neighbourhood, who, having many objects of interest in their possession, would prefer to see them deposited in our Museum, where they would prove of interest and afford instruction to many visitors, rather than keep them shut up in their own houses.”

The Curator of Botany reported :

“During the past year specimens of 140 local species, some rare, collected mostly by the late Mr. Banker between the years 1849 and 1856, have been kindly presented by Mr. T. R. Archer Briggs. I have had them all mounted, retaining the old labels, and placed in order. I find that 41 supply vacancies in the Institution’s Herbarium, wherein exactly 600 species of local plants are now represented.

“On the afternoon of June 18th a short botanical excursion was made to Old Newnham and Hemerdon, Plympton, Mr. Brooke W. Coaker and Miss Strode kindly granting permission to go through their grounds. Several plants were dissected in the field, and the family, generic, and specific differences pointed out, a young member of the party climbing later on an oak tree, and obtaining some large spongy oak-apples, in appearance like and as large as the root of the Jerusalem artichoke (*Helianthus tuberosus*), and which were compared on the spot with the small round currant gall and the hard dry gall nut. On the return the ruins of Plympton Castle and the Church of Plympton St. Maurice close by were visited.”

The Curator of Geology reported that considerable additions of much value had been made to the collection during the past year.

"1. The complete collection of the Osseous Deposit from Cattedown, presented by Messrs. Burnard and Alger, has been placed in the cases of the Museum. The examples have all been arranged, and described by Mr. Worth in a paper read before the Society during the past session, which will be published in due course in the Society's *Transactions*. The large masses of stalagmitic bone breccia, which were both too large and too weighty for the table cases, have been placed in vertical cases on the floor.

"2. The Silurian collection (Wenlock series) has been enriched by several specimens of corals, encrinites, and brachiopods. One large slab, nearly two square feet, contains many examples, including fenestella, many species of coral, encrinites, trilobites, brachiopods, and atrypa, rhynchonella, orthis, and strophomena. These have been presented by Mr. F. Brent, who has also deposited in the Museum case, on loan, a beautiful cast of the impression of the feet of the cheirotherium, or, as it is now named, labyrinthodon. The interest attaching to this, apart from its intrinsic geological value, arises from the fact of its being part of the first slab upon which such impressions were found in England fifty years ago (1838) at the Storeton Hill Quarry in Cheshire, about three miles south of Birkenhead. It is from the whitish quartzose sandstone of the Bunter or Lower Trias.

"3. Through Mr. G. C. Bignell a glass case, containing a rib, with vertebræ and sundry teeth of a shark, from the Post Tertiary phosphatic deposit of South Carolina, has been presented by Mr. James P. Cregoe, F.E.S. The whole are firmly secured to the case, which has been placed in the recess behind the stove.

"4. A valuable addition to the collection of Tertiary fossils has been made by a representative series from the recently-discovered Pliocene deposit at St. Erth. This was presented by the late Mr. Robert G. Bell, F.G.S., through Mr. Worth.

"It is not a little remarkable that of the four men who have been mainly identified with the elucidation of the geological problems presented by the discovery of the St. Erth bed about five years ago, no less than three—Mr. Searles Valentine Wood, Dr. Gwyn Jeffreys, and Mr. Robert G. Bell—have passed away.

"This bed, situated on the side of the valley which runs from Hayle on the north to Marazion on the south, indicates the

complete insulation of the western peninsula at the time of its deposit, when the water flowed freely between the two channels through this strait. From the evidence thus obtained, this must have been the condition at the close of the Miocene, but more probably during the Pliocene period. With the exception of the Miocene lake deposits of Bovey Tracey, in Devon, Ardtun, in the Isle of Mull, and Giant's Causeway, this is the only known Tertiary deposit in any part of the British Islands, independent of the boulder drift, outside of the two districts known as the London and Hampshire Basins. But as the Miocene deposits are entirely lacustrine, it follows that the St. Erth bed is the only marine Tertiary deposit in the British Islands, beside those of the south-east of England, and as such it has a special bearing upon the physical geography of this south-western part of the island at the time, and is therefore, from a local point of view, very interesting and valuable.

"5. By the provision of another table-case a sufficient amount of accommodation has been secured for the due display of the natural increase of the past year, as well as to relieve the previously congested condition into which the cases had fallen.

The Report of the Curator of Petrology was as follows :

"The Curator of Petrology is glad to be able to report the collection in his charge to be at length in such order that he is enabled to give a synopsis of its principal contents, with the chief localities to which the specimens belong. The classification is somewhat dependent on the space ; but Cases II. to VII. contain local rocks ; Case VIII. rocks of the United Kingdom ; Cases IX. to XI. foreign rocks. Case I. typical series.

"Case I. Typical specimens ; with some special local rocks, the leading rock-forming minerals, and examples from Raised Beaches :

"Typical series.—Granite, Dartmoor ; Shrift Granite, Hansdorf (Silesia) ; Pegmatite, South Africa ; Protogine, Mount Blanc ; Epidotic Granite, Dedham (U.S.A.) ; Syenitic Granite, Syene ; Syenite—Charnwood, Uddevalla (Sweden), Portland (Maine) ; Augite Syenite, Monzoni (Tyrol) ; Elæolite Syenite—Laven (Norway), Litchfield (Maine) ; Glimmer Syenite, Vosges ; Aplite, Jersey ; Granulite, Rohrsdorf ; Greisen, Geyer (Saxony) ; Trowlesworthite, Trowlesworthy ; Luxulyanite, Luxulyan ; Diorite, Guernsey ; Orbicular Diorite (Napoleonite or Corsite), Corsica ;

Quartz Diorite, Vosges; Lamprophyre, Campton (U.S.A.); Granophyre, Vosges; Felsophyre, Erzegebirge; Pallasite, Rhode Island; Lherzolite, Pyrenees; Olivine Rock, North Carolina; Olivine-Bronzite Rock, North Carolina; Dunite, North Carolina; Peridotite, Kentucky; Picrite, Schriesheim; Seyelite, Caithness; Kinzigite, Hesse; Eklogite, Silberbad.

“Lava; ditto Leucitic; Obsidian, Ascension, Yellowstone; Punice, Milo; Pitchstone, Arran; Tachylyte, Tasmania; Basalt—Curaçoa (2), Siebengebirge; Trachyte, Drachenfels (2), Siebengebirge; Perlite, Kremnitz; Amygdaloidal Lava, Keswick; Rhyolite—Siebengebirge, Arran; Rhyolite Tuff, Colorado; Melaphyre, Ilmenau; Liparite, Schemnitz; Dacite, Belabanyon; Dolerite—Lowenburg, Salisbury Crag; Diabase—Nahe, Niederschild; Olivine Diabase, Maine; Variolite; Kersantite, Erzegebirge; Porphyrite, North Berwick Law; Propylite, Kremnitz; Phonolite—Eifel, Wolf Rock; Gabbro; Diabase Rock, Belhelvie; Hypersthene Rock; Andesite, Curaçoa; Hypersthene Andesite, Mount Shasta; Hornblende Andesite, Mount Shasta, Siebengebirge (2).

“Gneiss, Eddystone; Archæan Gneiss, Channel; Augen Gneiss, Saxony; Hornblende Schist—Lizard, Bay of Nigg; Wavellite Schist, North Devon; Mica Schist, Shaugh; Talc-Mica Schist, Lizard; Schorl Schist, Seaswater; Hornblende-Talc-Felspar Rock, Lizard; Schorl Rock, Dartmoor; Elvan, Cann Quarry; Minette, Ballygowan; Cornstone, Saxe; Norite—Hartz, Keeseville (U.S.A.); Halleflinta, Norway; Serpentine, Lizard; Hornfels, Hartz; Lydian Stone, North Wales; Glacial pebble, North Wales; Siliceous Sinter, Iceland; Calc Tufa, Jennycliff; Travertine, Tivoli; Potstone, Polyphant; Quartzite—Gerrans, Budleigh Salterton; Siliceous Rock, Newton (near); Vitrified Killas, Hingston; Anthracite, Bideford; Lignite, Bovey Tracey; Retinasphalt, Bovey Tracey; Garnet Rock, Perran; Lode rocks (3); Gossan, Shaugh; Chlorite Rock, Virtuous Lady; Slate Breccia, Torbay; Bone Breccia, Plymouth; Porcellanite in Lava, Totnes.

“Rock-forming minerals.—Silica as Quartz, Flint, Calcedony, Chert; Mica, Felspar, Schorl, Hornblende, Actinolite, Tremolite, Asbestos, Talc, Augite, Calcite, Dolomite, Apatite, Barytes, Gypsum, Fluor, Chlorite, Epidote, Axinite, Pyrites, Hematite, Magnetite.

“Raised Beaches—Hoe 1839, 1884; Tor Bay, Barnstaple Bay.

“II. Local Groups.

“Rocks of Plymouth Sound, East and West—Slates, Grits,

Limestones, Traps. Rocks of Drake's Island. Rocks of the Channel area, chiefly crystalline, and of great interest. Sands and Stones from Fissures on Plymouth Hoe, 1887. Rocks of Devon Great Consols, Tincroft, and Golden Dagger—lode and 'country.' Lode rocks of Virtuous Lady, Bottle Hill, Belstone Consols. Killas with vein and crosscourse.

"III. Limestones, Sandstones, and Conglomerates.

"Limestones.—St. Merryn, Ilfracombe, Beer, Exmouth Bar, Plymouth, Torquay. Stalactite (polished)—Maldon. Marbles (polished)—Plymouth, Oreston, Radford, Billacombe, Pomphlett, Yealmpton, Chudleigh, Ogwell, Petitor, Ashburton.

"Grits and Sandstones.—Sconner, Scraesdon, Foss, Polperro, Ladock, Gerrans, Hessenford, Staddon, Drewsteignton, Okehamp-ton, Pickwell Down, Mortham, Baggy Point, Haldon, Totnes.

"Collection from the Lizard submarine Triassic outlier.

"Conglomerates.—Torbay, Teignmouth (with beach pebbles); modern shell-, Channel, near Eddystone; iron-cemented-, Batten.

"IV. Slates, Altered and Archæan Rocks.

"Slates.—Carzantick (Killas), Newquay, Westwood, Boyton, Tamar, (slickenside), Dockyard, Delabole, Cann Quarry, Prince Rock, Blackdown, Revelstoke, Okehampton, Pilton, Baggy Point, Yealmpton.

"Schorl Rocks.—St. Mewan, Caradon, Lee Moor, Ivybridge, Cadover, Plym Valley, Cornwood, Saddleback, Wigford, Meavy, Peek Hill, Collard, Two Bridges, Chagford.

"Contact-altered Schistose Rocks.—Shaugh, Collard, Meavy, Saddleback, Ringmore, Wigford, Cornwood, Ivybridge, Spitchwick, Caradon, Lee Moor.

"Altered Junction Rocks.—Shaugh, Lee Moor, Harford, Ivy-bridge, Ugborough Beacon, Clazywell, Great Tor.

"Archæan and allied Schistose Rocks.—Gneiss, Eddystone; Gneiss, Shovel Reef (?); Mica and Chlorite Schists—Salcombe, Portlemouth, Bolt; Micaceous Gneiss, Treluswell; Jasper, Chudleigh.

"V. Granites and Elvans.

"Granites.—Scilly, Lamorna, Ludgvan, Penryn, Colcerrow, Carn-sew, St. Agnes, South Caradon, Tregender, Roche, Gunnislake, Lizard, Treryn, Shaugh, Trowlesworthy, Meavy, Ivybridge, Great Tor, Princetown, Chagford, Sheepstor, Eylesburrow, Leather Tor, Heytor, Lundy, Brazen Tor, King Tor.

"Elvans.—Nine Maidens, Seveock, Wild Duck, St. Stephens, Perranzabuloe, Luxulyan, Pentewan, Malpas, Plints Barn, Lizard, Cheesewring, Morwell Down, Cann, Bickleigh Vale, Jump, Roborough, Ditto Rock, Okehampton, Shaugh, Cadover, Yannadon, Grenofen, Eylesburrow, Cornwood, Ivybridge, Lee Moor, Merivale Bridge, Bel Tor, Tavistock, Stollaford, Auswell Rock, Bittadon, Rivalton.

"Granulite.—Okement.

"Pegmatite.—Cornwood, Harford, Trowlesworthy.

"Luxulyanite.—Two Bridges, Peek Hill.

"Lithomarge Rock.—Lee Moor.

"Greisen.—Wigford.

"Granitic Silt.—Bed of Cattewater.

"China Stone.—Cornwall.

"VI. Lavas, Ashes, and Tuffs.

"Devonian (chiefly); Greston Bridge, Clicker Tor, Forder, St. Johns, Obelisk, Mount Edgecumbe, Polscove, Landrake, Weard, Albert Bridge, Ernesettle Beach, Saltash Road, St. Bude, Kings Tamerton, Honicknowle, Ford, Peveril Park, Milehouse, Swilly, Thornhill, Tor, Mannamead, Townsend Hill, Bedford Street, Stonehouse Hill, Widey, Egg Buckland, Compton, Lipson, Efford, Crabtree, Marsh Mills, Batten, Drake's Island, Colebrook, Hearston, Sherford, Brixton, Blackpool, Rattery, Dartington, Ashburton, Littlehempston, Staverton, Stoke Gabriel, Slapton, Highweek, North Lew.

"Triassic.—Thorverton, Silverton, Killerton, Pocomb, Washford, Cawsand.

"VII. Dolerites, Diabases, Serpentine, Gabbros, Hornblende and general Intrusive Rocks.

"Mica Trap.—Penryn.

"Dolerites.—Notter, Weard, Burraton Combe, Forder, Ernesettle (collection), Buckfastleigh, Anstey's Cove, Yarnar, Oddicombe.

"Diabases.—Rock, Yealmpton, Lydford, Seaton River, Yarnham (collection), Longstone (collection—serpentinous).

"Serpentine.—Lizard (collection, polished), Clicker Tor, Duporth, Polyphant (potstone).

"Gabbros.—Houndall, Awns and Dendles, Okehampton, White Tor, Wapsworth, Horndon, Cocks Tor, Brazen Tor, Lydford, St. Cleer, Coverack.

“Collection of Brent Tor series.

“Hornblende Rocks.—Lizard (Augen Gneiss, Hornblende Gneiss, &c.), Penlee (Mousehole), St. Cleer, Peek Hill, Ivybridge (with Ribbon Jasper = Prase Schist).

“VIII. British Rocks.

“Collections of Scotch Rocks (including granites of Mull, Orkney, Aberdeen; serpentines and dolerites), Channel Islands Rocks, Giant's Causeway, Charnwood Forest (syenites, lavas, and ashes); Purbeck, Portland Oolites, Chesil Bank, Chalk, Alum Bay Sands, Welsh Archæan Rocks (collection), Liassic and Carboniferous Fossiliferous Rocks, Marbles (Bethesda, Cotham), Tenby Beetle Stone.

“IX. European Rocks (chiefly).

“Polished examples from the Pyrenees, France, Italy, Russia.

“Collection of Alpine Rocks.

“Specimens from Gibraltar, Santorin, Egypt.

“Collection of Sands from various parts of the world.

“X. Miscellaneous Collections of Foreign Rocks.

“Grecian Rocks from Argos, Salamis, Athens, Piræus, Munichia, Poros, Paros, Phalerum, Hymettus, Argolis, Delos, Milo, Syra, Patras, Corinth, Arcadia, Port Rapti, Marathon, Zea, Mycenæ, Attica, Egina, Cape Sunium.

“Fossil Wood.—Arran, Barbadoes, Harwich, Suez, Sigri, Portland.

“Scotch pebbles (polished), Burnam and Mull chiefly.

“Collection of Phosphatic Rocks, &c. from Cerra Culebra.

“XI. America, Africa, and Oceania.

“Pumice from Krakatoa.

“New Zealand.—Examples from the pink and white terraces of Rotomahama (now destroyed).

“United States.—Basaltic Lava, Utah; Thinolite Tufa, Sinter from Yellowstone Geysers, Serpentine, Catlinite, &c.

“West Indies.—Collections from Trinidad (including bitumen), Cuba, Antigua, Curaçoa, Darien, Maranhão and Para (clay rocks).

“Collections from Ascension (chiefly volcanic), Bermuda, Cape Horn, Cape of Good Hope, St. Helena, Deception Island, King William Island, Fernando da Noronha, Madeira (raised beach) Staten Island. In these collections igneous rocks predominate.”

J. C. INGLIS,
H. PENROSE PRANCE, } *Hon. Secs.*

METEOROLOGICAL REPORT.

SUNSHINE IN PLYMOUTH FOR 1887.

MONTH.	Sun above the horizon hrs. min.			Sun shone in Plymouth hrs. min.			Percentage actual was of possible.		No. of days no sun-shine.
January.....	259	42	...	51	55	...	20·0	...	14
February	276	37	...	118	40	...	42·9	...	6
March	363	16	...	182	45	...	50·2	...	3
April	408	34	...	229	15	...	56·1	...	1
May	473	6	...	197	5	...	41·7	...	6
June	483	55	...	315	37	...	65·2	...	2
July	487	19	...	250	27	...	51·4	...	0
August	442	42	...	264	39	...	59·9	...	2
September.....	373	46	...	160	7	...	42·9	...	4
October.....	327	16	...	114	27	...	35·0	...	7
November	264	53	...	91	33	...	34·6	...	7
December	244	23	...	67	2	...	27·4	...	12

The sunshine for the year was nearly 42 per cent. of that possible, or the sun shone in Plymouth for more than two-fifths of the time he was above the horizon, while on 64 days he was not visible here. The temperature for the year has been nearly one degree F. below the mean, both days and nights having been colder than the average. February, March, April, October, and November were especially cold, whilst June and July were especially hot. The freezing point was reached in the screen on 48 nights. Rain fell on 144 days only, to the amount of 28·94 inches, which is about 80·5 per cent. of the average rainfall, and 78 per cent. of the mean number of rainy days. The deficiency in rainfall for the year was exceeded in 1870, when we had only 24·10 inches, and was about equalled in 1880 and 1884. The greatest rainfall for the year was on the 29th October, when we measured 1·54 inches. For nine months the rainfall was below the average, and from February to September the amount was

only 57·7 per cent. of the mean. This and many other parts of England suffered from the want of a proper supply of water during the summer months. On four days more than an inch of rain was measured in the twenty-four hours. The greatest atmospheric pressure for the year was on the 21st January, when it was 30·739 inches. The least was 28·801, on the 3rd November, the yearly average range having been 1·888 inches. The highest temperature in the shade was 85·3 degrees F. on the 19th June. The lowest was 23·4 degrees F. on the 17th February, the yearly range having been 61·9 degrees F. The hottest day in the sun was 147·5 degrees F. on the 19th July.

COLD MONTHS.—January, February, March, April, May, September, October, November, and December.

HOT MONTHS.—June, July, and August.

WET MONTHS.—October, November, and December.

DRY MONTHS.—The first nine months.

The number of mornings on which easterly winds have prevailed has been far in excess of the average, and there has also been a greater number of calm mornings, thus westerly winds with consequent rain have been far below the mean. The longest dry periods were from the 7th June to 8th July, and from 28th July to 16th August, during which periods no rain fell. The longest wet periods were from 25th October to 11th November, during which it rained every day, and from 25th November to 21st December there were only 5 dry days. Gales were experienced on 8th January, 22nd and 31st March, 28th and 31st October, and 1st November, causing much damage. Snow fell on only 2 days, both in March, and hail visited us in January, April, May, October, November, and December, thus reversing the rule of hail falling in the hottest months. Thunder storms were registered in April, May, and August.

J. MERRIFIELD.

5th April, 1888.

An ABSTRACT from the METEOROLOGICAL REGISTER, from 1st January, 1887, to 31st December, 1887, kept at No. 7, Hobart Terrace, Lipson Road, Plymouth (Lat. $50^{\circ} 22\frac{1}{2}'$ N., Long. $4^{\circ} 7'$ W.), by JOHN MERRIFIELD, LL.D., F.R.A.S., F.R.M.S.

MONTH.	BAROMETRICAL PRESSURE REDUCED TO MEAN SEA LEVEL AT 32° FAH.			TEMPERATURE.			HYGROMETER.				RAINFALL.		DIRECTION OF WIND AT 9 A.M.				
	Average Barometer for Month.	Maximum for Month.	Minimum for Month.	Average Maximum in shade.	Minimum.	Average temperature.	Average dry Bulb.	Average wet Bulb.	Average dew Point.	Average humidity, saturation, 100.	No. of days on which not less than 0.1 in. fell	Quantity for the month in inches.	From N. by E. to E.	From E. by S. to S.	From S. by W. to W.	From W. by N. to N.	Calm.
1887																	
January .	30.011	30.739	28.962	45.53	34.82	40.18	39.25	38.45	37.41	94	18	4.00	5	6	6	6	8
February .	30.323	30.663	29.827	45.90	35.74	40.82	39.74	38.48	36.84	90	8	.72	9	6	6	5	2
March .	30.111	30.651	29.442	47.78	34.11	40.95	39.27	37.11	34.30	83	10	1.53	10	4	1	8	8
April .	30.025	30.669	29.344	54.15	38.36	46.26	45.73	41.99	37.68	74	9	1.16	12	7	6	4	1
May .	30.064	30.467	29.543	60.34	46.06	53.20	52.83	49.00	45.07	75	15	2.09	15	4	1	9	2
June .	30.208	30.456	29.737	73.21	54.17	63.69	63.08	57.64	53.04	70	4	.40	7	7	4	2	10
July .	30.077	30.362	29.688	75.98	57.97	66.98	65.53	60.71	56.75	74	9	1.39	7	10	8	2	4
August .	30.012	30.366	29.592	72.27	54.76	63.52	63.59	58.44	54.10	71	8	1.30	9	10	6	5	1
September.	29.964	30.517	29.340	62.31	50.37	56.44	56.16	53.08	50.27	81	15	3.51	12	2	7	8	1
October .	30.159	30.653	29.527	53.94	41.97	47.96	47.15	44.58	41.70	82	11	4.22	8	2	2	7	12
November .	29.690	30.349	28.851	48.04	39.60	43.82	43.24	41.55	39.52	85	19	4.29	12	5	3	5	5
December .	29.908	30.525	29.411	48.85	36.26	41.06	40.29	39.28	37.97	92	18	4.33	6	4	7	7	7
Average for 1887	30.046	30.535	29.439	57.11	43.68	50.41	49.65	46.69	43.43	80	144	28.94	112	67	57	68	61
Average for 23 Years . .	29.953	30.403	29.320	57.73	44.87	51.30	50.46	48.53	46.58	87	185.6	35.94	79.3	61.5	101.6	81.8	40.7

The observations are all made at nine a.m. The Rain Gauge is by Casella, and 8 inches in diameter; its top is 9 feet 2 inches above the ground, and 131.2 feet above the mean level of the sea. A rainy day is one in which not less than 1-100th of an inch falls. The instruments have all been supplied by the Meteorological Committee of the Royal Society, compared at Kew, and the index error supplied to each.

ABSTRACT OF ADDRESS

AT THE OPENING OF THE SESSION 1887-8.

BY F. H. BALKWILL, L.D.S.,

President.

LADIES AND GENTLEMEN,—

There is perhaps no Science which has undergone so complete a revolution of late years as that of Metaphysics. At one time considered the Queen of Sciences, its methods were almost entirely dependent on introspection of the consciousness. This position was attacked about the end of last century by Gall and Spurzheim's so-called science of Phrenology, which at once became popular.

The cause of this popularity is not far to seek. Phrenology was founded to some extent on observation; so that there was considerable vitality in its nomenclature. It recognized and accommodated itself to an infinity of different modifications of personal character, which was a position abhorrent to scholastic metaphysicians, who sought to maintain the doctrine of the absolute unity of the mind, and hence an essential identity in the fundamental state of consciousness.

Phrenology also professed to be so applicable that an adept could give the approximate mental character of any subject by examining the shape of his skull. It thus became at once interesting to a great many persons, thanks to a laudable curiosity which is not entirely vanity; though it is doubtful if the old philosophical admonition, "Know thyself," was intended to be thus fulfilled.

The metaphysicians felt the attack; and later Sir William Hamilton, from 1836 to 1845, made numerous observations on human brains and skulls, and also those of some lower animals, with the view of exposing the fallacy of Phrenology. He

was completely successful in showing that the phrenologists were wrong in the functions they assigned to the cerebellum, and the mental faculties assigned to organs of the brain lying behind the eyebrows; and yet it may be questioned if he had not already given up the cause of pure Metaphysics as a lost battle, by bringing it to the practical test of observing the facts of action in connection with the functions of the brain. He may be said to have been the last of the scholastic metaphysicians of pure consciousness of any note.

Since that time the Physiologists and Pathologists have been winning points all along the line, and raising questions as to the unity or solidarity of the consciousness, and its separableness from matter, which the old metaphysical method has been found inefficient to answer.

This new departure in the science has proved of immense use in improved treatment of mental disease. In the last century the treatment of the insane seems to have been shameful: according to a work on *The History of the Insane in the British Isles*, by Dr. Hack Tuke, chains, flogging, and exposure to the climate without clothes were by no means the worst of the common treatment. That this treatment arose entirely from the scientific opinion of the unity of the mind I should be loth to maintain. It is as difficult to imagine that it arose from pure inhumanity; and it was, to a certain extent, the logical outcome of a belief in the unity of the mind; for if the mind were an elementary substance, essentially distinct from matter, the delusions of insanity could only be understood as obstinacy, wilful error, wickedness, possession by the devil, &c. Such an explanation raised combative feelings in the caretaker, and resulted in harsh and punitive treatment. Whatever the connection may be, it is certain that on parallel lines, with advance in knowledge of the connection between the nervous system and the mind, there has been an ameliorative and more humane treatment of the insane.

As was well said by an ancient eastern philosopher—Confucius, I think—"Let knowledge be increased. When knowledge is increased, the way is made easy. When the way is made easy, the heart is enlarged. When the heart is enlarged, the country is at peace."

It is not to be supposed that Phrenology is to bear all the honour of this change of front. The general advance of the

correlative sciences, as well as the use of the microscope, alone made it possible.

Still, to quote Ladd, "it is a surprise, from which investigation can never recover, to find that the connection between our sensations, mental images, and volitions, and the peculiar material constitution and functions of the cerebral mass of nervous matter, should be so intimate as it undoubtedly is."

The doctrine of Evolution also had a helping hand in drawing attention to the relative facts of mind and nervous system; for if the mind, as we find it in human beings, was placed ready-made in the human body, with all its emotions and capacities for actions and re-actions, a solution of the manner of their connection seems at once hopeless; but if, on the other hand, mind and body have grown up together through a struggle of ages from the most elementary form, their intimate connection would be natural, and their relations capable of being traced. Those who pursued this enquiry in Comparative Physiology found facts to accord with this conception.

Without recapitulating the order and increment of complexity, it may be stated that the fundamental part of all nervous systems seems to be a central cellular or granular mass, supposed to be capable of sensation, forming ideas, purposes, &c.; from this, or these ganglia, nerves run to the extremities and other parts of the body. These may be classed under two heads. Around one class are formed the active organs of the body, as muscles and glands; around the other class are grouped the perceptive organs, as eyes, ears, &c. The generally received opinion is, that stimuli from the external world, impinging on the perceptive organs, cause these to transmit a message to the central ganglia, where an idea is formed from the message, judgment formed as to the relative import of the information received, and a suitable combination of active organs stimulated through the other or efferent nerves to make what efforts the exigencies of the case require. In man there are a great many of these ganglia, known as the spinal cord, the medulla oblongata, cerebellum, cerebrum, &c., as well as a great many smaller ones scattered about the body.

This circle of action, *i.e.*, first external stimulus on the organ of sense, transmission of intelligence to central ganglia, and transmission thence of co-ordinated action, is called the law of "reflex action."

Such of these actions as must, from the necessity of things, have been continually or commonly recurring, seem to have become automatic, *i.e.*, proceed from the external stimulus without any further consciousness or judgment being used. For instance, Ferrier (page 35) found that "a fish deprived of the brain maintains its normal equilibrium in the water, and uses its tail and fins in swimming with as great precision and co-ordination as before. It is, however, continually on the move. Left to itself in the water it swims in a straight line, and unlike other fishes, which stop to smell or nibble at this or that, it keeps on its course as if impelled by an irresistible impulse, and is only stopped by the sides of the vessel, or worn out by fatigue." The sensation of the water on the skin supplied the stimulus which resulted in the continued swimming.

It will be seen that the question of the unity of consciousness is here raised. The fish had lost in its brain the higher conscious or judging-power instructed by the various organs of sense, and therefore these no longer influenced the spinal cord; but the query remains, whether the spinal cord itself is conscious in its co-ordination of the swimming muscles. If merely automatic, it is still usually under the power of the higher nervous centres, as its actions are modified when in connection with them by their particular direction. Another question arising here is, Whether the action of the spinal cord, if merely automatic and unconscious, was so always? or was it initiated in consciousness, and has it, after ages of use, passed out of consciousness?

The law of reflex action is a very general one, and a great many actions which we are perhaps accustomed to regard as voluntary or intelligent, are really produced by reflex action on a previously prepared nervous connection. Take for instance the act of reading. By slow and continual efforts we have established a nervous connection between the visual shapes of printed or written words, their sound to the ear, their oral utterance, and the usual meaning or relation which they have to our every-day actions. When we read, our action is almost entirely reflex; the sight of the words excites the corresponding idea or purpose in the sensorium of the brain, which combines and sends out the very complicated muscular actions which produce the articulate voice. In the case of blind people, who can read by feeling with the fingers, the probable initiation of the connection may have been by writing.

We have here seven or more different sets of reflex actions over words.

1. In three ways by hearing. We can have a word—say the word *run*—excited in the sensorium. This can be reflected through the mouth by our repeating the word, or through the hand by our writing it, or through our legs by running.

2. In three ways by seeing. We read the word *run*, which, exciting the central motor centre, can issue forth by vocal utterance, by the hand in copying the word, by the legs in running.

3. By feeling. As in a blind man reading, which usually only issues out in action as reading.

There is the still wider and probably older set of reflex actions connected with words, where all the various conditions under which we are placed produce thoughts or states of mind which we wish to communicate to others. In this there has to be a deal more intelligent effort used to find the right words; but the history of persons possessed of great gifts in this respect points to the fact that there has arisen in the human sensorium certain connections between particular states of thought or feeling and words, so that the appropriate expression naturally occurs.

Persons under great excitement or peculiar conditions utter often peculiar and unconventional phrases, which, however, at once strike the hearer as appropriate or natural, showing some previous connection between the thoughts and the words.

It is the word which excites the appropriate action in its complexity, the consciousness or will only giving it permission to go forth. This will perhaps be made plainer if I give in illustration the cases of Aphasia, or loss of speech; and Agraphia, or loss of power of writing, from disease of the speech centre in the brain. To quote Ferrier: "Examples of all these different conditions are to be met with in those afflicted with Aphasia. Some can neither speak nor write; some can write, but cannot speak; some can write their names, but nothing else. All can comprehend spoken language; many can comprehend written language; others not at all, or only imperfectly."

To quote Ladd: "Aphasia is far more frequently due to changes in the left than in the right side of the skull. Out of 260 cases, Dr. Seguin found the lesion in 243 on the left side, and only 17 on the right." This is no doubt due to the

fact that the right hand is usually used in writing, as motor stimuli would cross over from the left to the right side, according to a well-known law or fact. He goes on to say, "Remarkable cases of left-handed people, who have become aphasic through lesions of the right hemisphere, are actually recorded." It must be remembered that intelligence in other respects is apparently unimpaired; the articulating muscles of mouth and voice are not paralysed, and can be used in other acts, as also the writing muscles of the hand and arm can be used voluntarily and intelligently.

The illustration occurs to us that it is somewhat like a very complex railway junction, connecting a great many different lines, but some catastrophe has broken up all the lines, turning-tables, and shunting-levers, into a confused marsh of soft clay and broken iron; so that when the trains come in from their separate courses they are lost, and can no more issue on the right routes.

But what would Socrates have said to this—"I am he who is talking to you, not that which you will soon see buried"? Yet in this case we see that the "he who talks to you is gone;" and yet, at any rate, part of the intelligent being remains with his body, which is not yet buried.

Shakespeare seems to have perceived the fact of there being subordinate motor centres. You may remember the scene in *Macbeth*, where he is waiting for the time to arrive when he shall murder Duncan. The motive centre forms the idea of a dagger, which is about to be used; but as the action cannot yet issue forth by the hands and arms, the intense excitement actually forces the idea down the optic nerves on to the retina, so that Macbeth fancies he sees a dagger in the air before him, and commences his soliloquy:

"Is this a dagger which I see before me?" &c.

Also in *Julius Cæsar*, where Brutus is contemplating the assassination of Cæsar.

"Between the acting of a dreadful thing
And the first motion, all the interim is
Like a phantasma, or a hideous dream:
The genius and the mortal instruments
Are then in council; and the state of man,
Like to a little kingdom, suffers then
The nature of an insurrection."

But does not this lead us to Materialism? I do not think that necessarily it does; but still I am afraid that the arguments as against Materialism, drawn from introspective considerations of the consciousness, in attempts to isolate it from matter by attributes of unity, inextensibility, indivisibility, and solidarity, must be considered at present, at any rate, as having the weight of evidence against them. One great gain has certainly been attained in its being made clear that training is of much greater value than scolding in producing right action.

It used to be a philosophical apothegm, if not originally an oracle, that the highest knowledge was "to know that we knew nothing," which may have had three meanings. 1. That as a maxim of humility it was a good and wise position to take. 2. That the common-sense or knowledge of mankind, although a sort of knowledge, was usually so powerful that it was only the highest intellects that were capable of examining its nature, and who then found it so aberrant and unaccountable, that all they could say about it was that they only knew that they knew nothing. 3. That at the time of its utterance it was perceived how much there was to be known, but how little they then knew.

This maxim has been beaten out perhaps in almost every direction to absurdity. Some philosophers have denied that mind existed; some, as Berkeley and the idealists, that matter existed; whilst Hume, who was more consistent, denied the existence of either, and affirmed that only a sequence of sensations existed. Even Sir W. Hamilton considered that we had no absolute knowledge.

He says, "I virtually assert we know nothing absolute—nothing existing absolutely; that is, in and for itself, and without relation to us and our faculties. I shall illustrate this by its application. Our knowledge is either of matter or mind. Now what is matter? Matter, or body, is to us the name either of something known, or of something unknown. . . . In short it is a common name for a certain series of appearances manifested in co-existence.

"But as these phenomena appear only in conjunction, we are compelled to think them conjoined in something. But this something, absolutely and in itself, is to us as zero. It is only in its qualities or effects that it is cognizable. That which manifests its qualities is called the substance. To this substance of the phenomenon of extension, solidity, &c., the term matter or

material substance is given, and is therefore as distinguished from these relative qualities unknown and inconceivable.

"The same is true as regards mind. In so far as mind is the common name for the states of knowing, feeling, willing, desiring, &c., of which we are conscious, it is only a name for a certain series of connected phenomena, and consequently expresses only what is known. But in so far as it denotes that subject or substance in which these phenomena inhere, it expresses what in its absolute existence is unknown."

But is not this overstating the case. That our senses often give us false impressions is true, and that their information is very partial and often insignificant, must be allowed.

Take the illustration most commonly given, that of sound. If we hear the blow of a hammer on an anvil, it appears to us that the sound is produced there where the hammer touches the iron. If we hear it at a greater distance we hear the sound some time after we see the blow fall, and it appears then to us that the sound has traversed the space straight to us from the blow. But when we find that all persons standing at a distance in a circle around the anvil hear the sound after the blow is struck, but at the same time as one another, we get the idea that the sound has travelled from the centre like a circular ripple on a pond when a stone is thrown in; and when we find that the same holds good in all direction of space, we get the idea that the sound has progressed like a rapidly-expanding bubble. Still we conceive it as sound proceeding in this form. But when we are shown that sound is only a sensation produced in the ear, not at all like what produced it, we gain the further conception of this bubble being only a film of compressed air, or motion communicated to the particles of air without their being any sound at all outside our ear. The question arises, What has become of our absolute knowledge? We thought we were absolutely certain "we heard a sound."

If anything exists and has relations, including actions and reactions, what do we mean by having absolute knowledge concerning it? Is it not absolute knowledge if we know that it does exist, and has such and such relations, actions, and reactions? What more can there be to know about it?

To say therefore that we do not know anything absolutely about the substance of matter or mind seems to me in reality

only to amount to saying that we cannot know all their relations, actions, and reactions, which may or may not be true.

Now we know that matter exists by the sensations it produces in us, which is one of its relationships ; and we also know that its actions must differ relatively, as there are relative differences in these sensations. For instance, the sound in our ear may be said to be unlike the blow of the hammer on the anvil, yet in the same relation as those blows fall will be the sounds in our ears ; as they are heavy or light, slow or quick, so will the sounds be in our ears. So that I think we may still say correctly that we are absolutely certain we heard the blows, although we certainly do not know all the relations, actions, and reactions set agoing by those blows.

The argument for the materialist therefore lies something like this : It is not a good argument to say that the mind is not a quality of the body because it does not feel a bit like the body looks ; as that is merely saying that it does not feel, when you are in it yourself, like it appears to the organs of sight when in another person, or like certain portions of the anatomy appear when dead.

It seems to me that so far the materialist has the best of the argument, and that we shall have to shift the field of battle to the primordial cell from which all life comes ; for if it can be shown that of two cells originally precisely the same, as far as material qualities are concerned, one proceeds to become a Tomtit and the other a Turkey, it will go hard with the materialist to deny something within that cell beyond its material qualities.

CONVERSAZIONE.

(6th October, 1887.)

AN account of the proceedings will be found in the
Report of the Secretaries.

THE CATTEDOWN BONE CAVE.

BY R. N. WORTH, F.G.S.

(Read 20th October, 1887.)

THE bone caves of the Plymouth district must always occupy a leading place in the history of cave research in England, for the bone-bearing fissure discovered by Mr. Whidbey, in 1816, in the Breakwater Quarries at Oreston, was the first cavern made the subject of definite scientific investigation in this country. It is the more needful to insist upon this fact, because no one would rise from a perusal of the general cavern literature of England with a clear idea of its importance. Every writer upon bone caves has, perhaps not unnaturally, shown a most paternal regard for the reputation of his own child or children; and the example seems too good to be ignored. Not, of course, that I had anything to do with cavern exploration carried out more than threescore and ten years ago; but the fact remains, that all who were concerned in the investigation of our local cavern phenomena for more than a generation were either members of, or in some way connected with, this Institution; and that as a society we have every reason to be proud of the work they did. It is quite true that for a while this special form of scientific enquiry appears to have been neglected here, but discoveries seem then to have been few and comparatively unimportant; and since an active interest has been revived, during the past ten years, "find" has followed "find," culminating in the unprecedented discovery at Cattedown.

There is no need to recapitulate the history of local cavern research. So far as I know, that story is fully told, and every available reference given, in the paper on the "Bone Caves of the Plymouth District," read before this Society on the 29th February, 1879;¹ and in the supplementary paper "On an Ossiferous Fissure

¹ *Trans. Plym. Inst.* vii. 87-117.

in the Battery Hill, Stonehouse," read October 9th, 1879.² These papers brought together all the information that could be gathered from various writers who had treated on the subject; from the collections of the local bones deposited in various museums; and embodied also the results of my own investigations. To them, and as illustrating them, to the contents of our Museum, I must refer those who wish a fuller view of "cave hunting" as it affects this neighbourhood. It will be sufficient now to say that ossiferous fissures or caverns are recorded from Oreston in 1816, 1820, 1822-3, 1843, 1858-9, and 1878-9, with an uncertain year between 1823 and 1843; by Oreston understanding generally the quarries south of Cattewater from Turnchapel to Pomphlett. That there have been at least three finds on the Hoe—one uncertain, and the others about 1838 and 1844. That Stonehouse has also had at least three—about 1835, in 1865, and in 1879-80. That there was one at Mount Wise in 1861. And that the quarries at Cattedown are known to have yielded bones on more than two occasions previous to the present discovery—one of them, a find in Deadman's Bay some years ago, coming to my knowledge long since the reading of the papers cited.

The opinion expressed by me in 1879, that few years had passed during the previous forty "without some fossil bones occurring in the Oreston quarries," has been greatly strengthened by subsequent experience. Taking the whole range of the Plymouth limestone, I am convinced that if all the "finds" had been recorded, we should probably treble the number of instances now known, though the quantity found would in most cases have been small.

One of the leading points of criticism on my original lecture was my inclusion of man in the local cavern fauna. I ventured to suggest that if "the earlier investigators of our bone caves had been true to the claims of science, the question of the antiquity of man would not have been left to be settled by the present generation." And I adduced instances in which those early investigators shut their eyes to the evidence of man's presence; and others where they went further, and destroyed it.³

² *Trans. Plym. Inst.* vii. 504-507.

³ *Op. cit. Trans. Plym. Inst.* vii. 99, 100.

My friend, Mr. Pengelly, commenting on the paper,⁴ expressed a doubt whether proof of the presence of man in the bone caves first investigated would really have advanced the acceptance of a belief in the high antiquity of the human race; and I am quite ready to admit that I may have under-rated the non-receptivity of new ideas in the average individual. Still, the point would have been forced to the front if there had been no concealment or destruction of evidence; and I held, and hold, that this alone must have been a gain.

Be that as it may, it was perfectly clear to my mind that there was no ground for doubting the deliberate statement of our late distinguished member, Colonel Hamilton Smith, on which I founded my inclusion of man in the Oreston fauna—that he had himself seen a human bone from an Oreston cave, which was thrown away directly he pointed out its character. The actual assertion was, that among bones from the Oreston caves he “detected the upper portion of a humerus of man, which was immediately thrown away upon being pointed out to the possessor.” And he added in a note, “This is not the only instance of the kind. Collectors in the plenitude of ignorance and prepossession determined that human bones were of no consequence.”⁵

The present discovery of the remains, not of one, but of several human beings in a bone cave at Cattedown, are some evidence that this accomplished naturalist was not likely to have been mistaken, and my reliance on his authority not so very venturesome after all. It is to me as great a satisfaction to claim for Colonel Hamilton Smith the honour, which undoubtedly belongs to him, of being the first scientific authority to accept man as a member of the English cave fauna, as it is to myself personally to be able to lay before not only this Society, but the scientific world, the most satisfactory and complete physical evidence extant of the human contingent of our Western cavern fauna, in their own proper persons. Not that the interest of the Cattedown cave is by any means confined to the relics of man; but that our ancient cave men have, as we shall see, put themselves at last upon record in such an emphatic manner as to compel recognition by the most sceptical, and to relegate the remainder controversy to side-issues of easy disposal.

⁴ *Trans. Devon. Assoc.* xvii. 426 *et seq.*

⁵ *Nat. Hist. Human Species* (1848), 95, 96.

The limestone quarries at Cattedown have been worked for ages, but a period of exceptional activity set in some ninety years since; and at various points the cliffs were worked back from Cattewater to some distance inland. In spots these operations were then abandoned; in others they have continued to the present day. One of the localities where excavation ceased became the site of Messrs. Hill's shipbuilding yard, recently acquired by Messrs. Burnard, Lack, and Alger for the extension of their manure works. Messrs. Burnard and Alger have constructed extensive wharves on their waterside frontage in Cattewater; and in connection with this have partially reworked the old quarry at the back of the ship-yard, at a lower level, the foot of the new face being twelve to fifteen feet beneath the level of the old floor, part of which was long used as a garden.

This quarry, in the first instance, was wrought to a depth of sixty feet below the original surface of the hill; and the old floor was partly overlaid next the cliff by a spoil-bank of earth and small stones, which formed a talus.

Soon after excavation commenced, in autumn of 1886, the men broke through the east wall of a fissure containing earth and small stones, and ere long found a few bones, of which they took no heed. Subsequently more were discovered, and then the attention of Mr. Robert Burnard was called to them. These bones were bovine and of little note; but Mr. Inglis having told me of the circumstance, the possibility of their having successors led me to call on Mr. Burnard. He at once kindly promised that all care should be exercised in the further excavation, and that whatever turned up should be put aside for my examination. We have, however, to express our hearty thanks for very much more than this. The firm have spared neither trouble nor outlay in the explorations to which circumstances afterwards led; and Mr. Robert Burnard has given the work a personal attention and supervision, for which we cannot be too grateful.

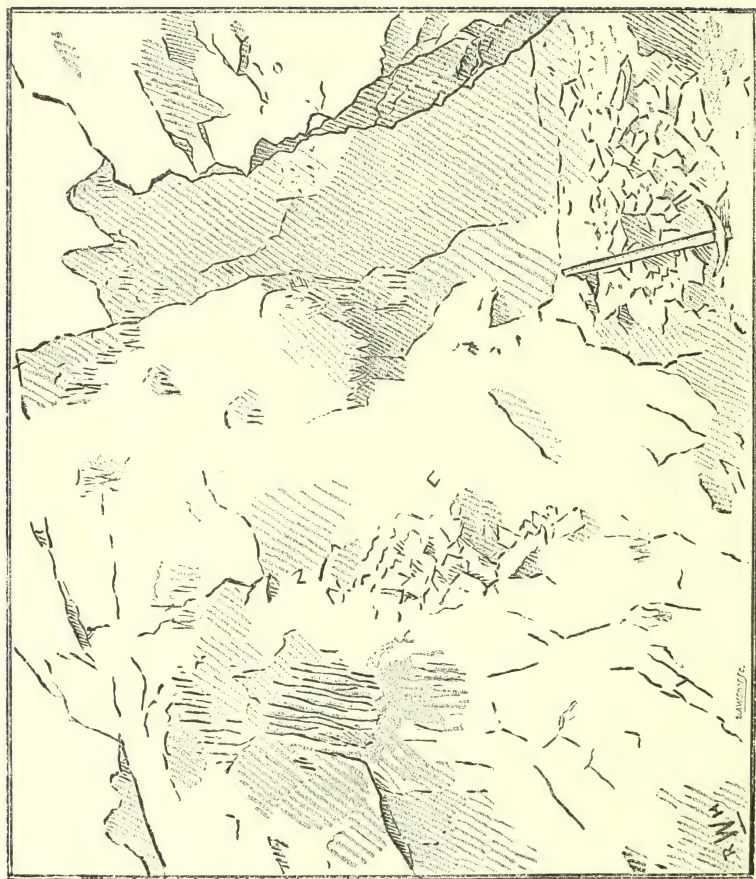
It was not long before a fresh discovery was made, and this time bovine and caprine were accompanied by human remains—fragments of a skull, a lower jaw, and a number of phalanges; but there was no distinct evidence of their position. The material had now been cleared sufficiently to reveal a considerable fissure running north and south, and open to the floor of the old quarry—

the roof having been broken in by the former quarrymen, and whatever vacant space existed filled with portions of the spoil-heap. There was nothing to suggest, but at the same time there was nothing absolutely to disprove the suggestion, if made, that the remains, whether ancient or recent, had been thrown into the fissure during the former working. True, they were found at the lowest point of the excavation, and were not associated with the distinctive spoil; but as they might have slipped downward during the digging, all that could be done was to keep a careful watch for more definite indications.

An examination of the cavern, for such it proved to have been—an irregular tunnel with a chamber at each end—showed that there was no difficulty, when the face of the contents was once fairly cleared, in distinguishing between the recent filling and the older deposits. The exploration of the northern end—the eastern wall having been removed for some thirty feet—was first undertaken. The section here showed the upper part of the fissure to be filled with portions of the spoil-bank, which was a mixture of earth and small stones, the former predominating. Beneath this was the upper section of the bone-bearing deposit, which consisted almost wholly of large stones with a little earth and clay; the stones being such as quarrymen would have utilised had they come in their way, and the division between the two deposits being perfectly distinct.

As excavation proceeded the bone-bearing deposit became more productive. Moreover, it increased in thickness by rising towards the end of the fissure, and became infiltrated by stalagmite until it assumed the character of an open stalagmitic-breccia of large eroded stones, between which there were frequent cavities containing quantities of bones. There was no reasonable doubt that the bulk of these stones had fallen from the roof.

When the greater portion of this filling had been removed down to the modern quarry level, it was found that the fissure narrowed upwards at its termination into a mere flue; that the stalagmitic-breccia remaining in the end was too compact to be dealt with by ordinary methods; and that upon it were the remains of a stalagmitic floor, partially broken, apparently by the fall of heavy blocks. The breccia had increased in thickness by the gradual northward rise, from the first appearance of a stalagmitic character, from two to four feet.



SKETCH OF CATTEDOWN CAVE.

The sketch annexed, from a photograph by Mr. D. Roy, shows this northern chamber with the loose material removed and the stalagmitic-breccia exposed.

Under the direction of Mr. Robert Burnard a hole was bored in the rock at the back of this mass to blast it out, and was charged and fired in my presence on the 29th of April, 1887. A great many bones were then exposed to view, coated with or imbedded in stalagmite, but mostly fragmentary. The stalagmitic floor was found to have varied in thickness from an inch to a foot, and while the walls of the fissure were for the most part coated with stalactite (which at one point had cemented a mass of stones firmly to the side), the rock immediately beneath the inner edge of the floor was perfectly clear. The breccia therefore was, at least in part, of older date than the stalactite, as well as the stalagmite, with which it was associated ; while the copious flow of stalactitic matter on all accessible portions of the walls was another proof that after the bones had been deposited the cavern had remained a cavity. The integrity of the breccia was clear.

Immediately after the blast I myself took out from what had been the heart of the stalagmitic mass, portions of a human skull, and a human molar tooth with a fragment of jaw attached, associated with the remains of the hyæna, wolf, red-deer, and roe-deer. Other fragments of the skull were subsequently found imbedded in the stalagmite.

When this breccia had been removed to the quarry level—which left, as was afterwards found, a small quantity beneath at the inner end of the fissure—a trench was dug two feet deep at the entrance of the northern chamber, and the material removed to this depth right away to the back. The outer part of this section was wholly distinct in character to the stalagmitic-breccia, consisting of small angular stones and chocolate-coloured clay—a cave-earth—so tightly compacted as to resemble concrete. Hence it obtained the casual name of the “concrete-floor.” In the end this in part gave place to the more open breccia, infiltrated with stalagmite. A small portion on the same level next the eastern side consisted, however, of a close granular stalagmite, with angular fragments of stone ; and this gradually thickened and broadened northward, and eventually occupied the extreme northern end of the fissure almost to the lowest point excavated.

The concrete-floor yielded chiefly small fragments of bones and teeth. Northward there were more bones and fewer teeth, and the open stalagmitic-breccia in the end, in character and productiveness was precisely similar to the breccia above. The close granular stalagmitic-breccia was less productive at the level, and in depth became barren.

In the stalagmitic-breccia remains of deer were peculiarly abundant; and human bones, comprising the remains of complete skeletons, were chiefly associated with those of red-deer, roe-deer, hyæna, wolf, and fox.

In the concrete-floor remains of hog were so prominent as to be characteristic. Here human teeth were chiefly mingled with those of hyæna, wolf, boar, and badger.

At the very end of the fissure, seven feet below the stalagmitic floor, and at the deepest point in the breccia at which bones were then found, there lay portions of a human upper and lower jaw.

The concrete-floor was carefully examined *in situ* by the man who removed it, and every recognised fragment of bone put aside for my examination. The stuff was afterwards examined on a table under the direction of Mr. Robert Burnard. That gentleman also washed and picked over, with the aid of a magnifying-glass, some of its looser and finer components, finding a quantity of bones and teeth of the shrew, water-vole, and mole. The same results attended some of my own examinations of the clayey matter washed off from the bones; and in the breccia there were, in addition to the water-vole and mole, bones and teeth of the bank- and field-vole and bat.

Mr. Burnard then determined to trace the fissure towards Catte-water. When he commenced excavation, the section southward appeared to indicate that the entrance of the cavern lay in that direction, not far from the sea level. The filling was much looser, and consisted largely of the material of the spoil-bank. A few bones and teeth of ox and sheep or goat were found near the level of the quarry floor, but nothing of consequence; and the chief fact ascertained was that the southern chamber terminated in a mere joint crevice. As the bottom, however, had not been reached, the whole of the material in the chamber was removed to a depth of nine feet, where it closed in to a joint; but with little further result. This filling was more stony and

clayey, but not compact—quite distinct from the spoil, and a genuine cave-earth; and though the walls of the fissure were coated with stalactite, no stalagmite was seen. With the exception of a fragment of a human humerus and some teeth, only bones of ox and hog were found in the lower excavation; and these in small quantity.

The filling in the intermediate part of the fissure, connecting the two chambers, was next dug out to a depth of two feet, where it narrowed to a mere crack, and with somewhat better fortune—remains of ox, deer, wolf, hyæna, and man being found, with a coprolite. Fragments of what had the appearance of being coprolitic matter had been noticed in the breccia, but nothing clearly identifiable.

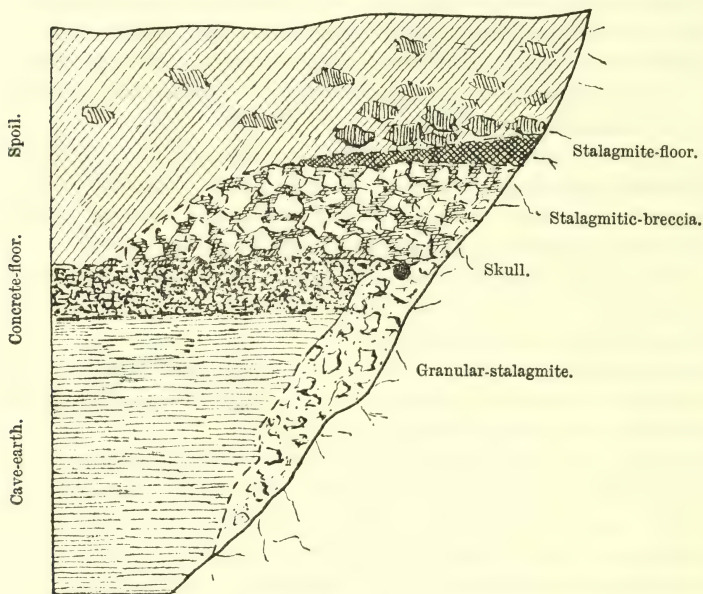
A return was then made to the entrance of the northern chamber, and sinking resumed, this time with important issues, in material generally resembling that of the concrete-floor, which was indeed only its upper and more consolidated portion.

The fissure was quickly found to open into what at first appeared a lower chamber. It did not narrow so rapidly or so much as elsewhere, and at a depth of four feet began to expand, eventually widening on the east, where the rock overhung, to a width of eight feet. Instead of a lower chamber, it was in reality a continuation of the upper on the dip of the strata. This was then excavated to a depth of fifteen feet below the quarry floor, without reaching the bottom. Southward it was found to be closed, save for the jointing; but that an open crevice continued to the sea was evident from the fact that at spring tides the water found its way into the excavation. The total depth of material excavated from the top of the fissure to the bottom of this chamber was twenty-seven feet, and of this twenty were more or less ossiferous.

A noteworthy fact about this chamber was, that while the upper part of its southern portion was filled with closely-compacted cave-earth, there was a considerable space unoccupied next its eastern or undercut side. The reason of this was perfectly plain. The material gradually falling from above had formed a talus, the upper part of the slope of which had closed the aperture before the space below was filled. The free face of this talus was covered with a thin coat of stalagmite, and at nearly the lowest depth

reached in the southern end of the chamber there were slight remains of a partial stalagmitic floor.

The material of the lower filling varied somewhat, but still presented the character of a regular series. At the bottom of the chamber there were small stones and chocolate-coloured clay. Immediately above the stones were larger, and with less earthy matter; and there were portions where the stones were larger still, and practically free from earth. The longer axes of the stones followed the slope of the talus.



Northward this deposit passed into the mass of granular stalagmitic-breccia, which filled the end of the fissure to an ascertained depth of fifteen feet, underlying the bone-breccia which had proved so rich, but, save in its upper portions, being itself all but barren. Nor was the quantity of bones found in the lower part of the northern chamber large. Moreover, they were, as a rule, thinly scattered, except in one spot, which yielded the remains of hares, rabbits, smaller rodents, and birds. This fact suggested that when the main opening to the lower part of the chamber had been closed, there still remained an aperture,

through which relics of small animals might have found their way, after access was barred to the larger. The most important fact elicited by the examination of this part of the cave was the association of bones and teeth of man, not only with hyæna, wolf, fox, deer, ox, and hog, but with the lion and the rhinoceros. The ancient character of the cavern fauna was emphasized.

The order of the deposits in the northern chamber is shown in the section opposite.

When completely explored, it was seen that the cavern consisted of a gallery, running north and south on the natural jointing of the rock, with a chamber at each end, the total length being fifty-four feet. At the point first opened, on the east, it had a breadth of four to five feet, and its walls were approximately perpendicular.

At its northern end it expanded, near the level of the quarry floor, into a chamber, overhanging on the east; while its western wall still remained practically perpendicular. This chamber again narrowed to its termination, which was formed by a narrow face of rock sloping southward, and it contracted so rapidly above as to give the impression that originally the gallery did not rise much above the dozen feet of rock which remained unworked on its western side, at the modern quarry level. But the total height, taking the results of the excavation into account, must have been much more than double this. The length of this chamber was twenty feet, and its greatest width eight.

The southern chamber was twenty feet in length, more regular in shape, and did not exceed five feet in width. Its depth below the quarry floor was not more than nine feet. From the fact that the connecting fissure, or gallery proper, narrowed rapidly downwards, the lower parts of the two chambers were separated from each other by nearly twenty feet of rock.

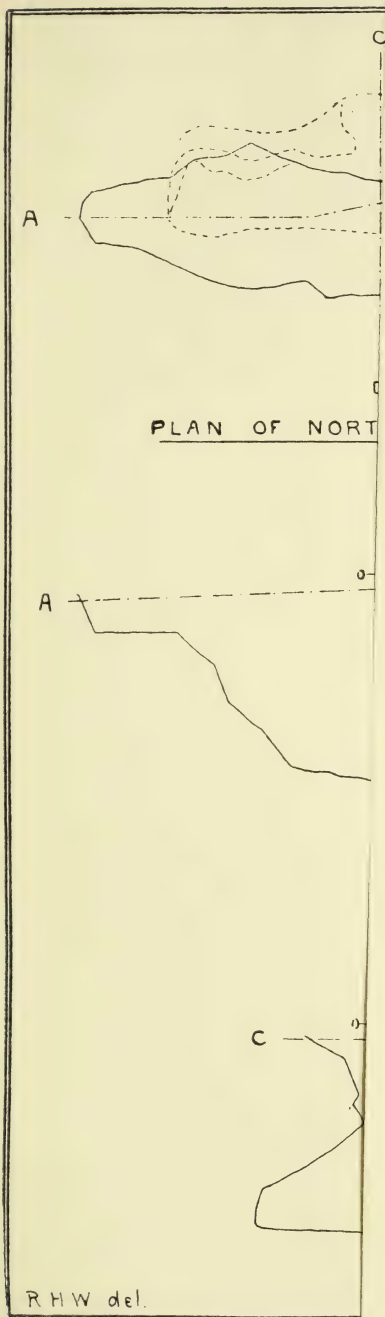
The natural entrance to this gallery and its chambers was evidently from above, and apparently near the northern end. There is no reason to doubt that the cave formed the descending branch of a large cavern or series of caverns, of which several traces remained in the hill above. There was direct evidence that the fissure had not extended to the surface. The character of the stalactites and stalagmites made it clear that it had originally a roof; and it was equally evident, from the position occupied by the spoil-heap, that it must have been to a large extent empty when first broken into. The very considerable stalagmitic infiltra-

tion at the northern end of the cavern points also to the existence of a considerable superincumbent mass of rock.

The details of the cavern are exactly set forth in the accompanying plan and sections, drawn to scale from careful measurements by my son Mr. R. H. Worth. The datum is 17.70 above Ordnance.

A review of the whole facts enables us to distinguish between, at least, two distinct series of deposits: the open stalagmitic-breccia above; the concrete-floor with its ordinary cave-earth continuation below. The conditions of the remains in each were widely different. Those of the concrete-floor and underlying cave-earth were generally casual in occurrence; had all the appearance of gradual accumulation; and, save in the case of smaller mammals and birds, yielded nothing approaching to a complete skeleton: though there was evidence that portions of bodies, at least, had been deposited intact. In the stalagmitic-breccia, on the contrary, the remains were chiefly of what had been complete skeletons. Again, while deer predominated in the breccia, and hog was specially plentiful in the concrete-floor, the breccia abounded in remains of young animals, and those of the cave-earth were chiefly of mature.

But the most marked differentiation was the fact that the remains of the breccia were those of animals which must have found their way thither for the most part intact. Many of the bones were too fragmentary to allow of the recovery of complete skeletons; but there was very good proof in the majority of cases that such skeletons had been present. Bones of individuals were found in such intimate association as wholly to forbid the supposition that they had been moved since the flesh and integuments had decayed. From one cavity, around which the stones had been gradually cemented, I took out bones and fragments representing practically the entire frame of a deer. A mass of small bones, huddled together in a nodule of clay, proved to be the phalanges of a wolf, and with them were the teeth of the same animal. In several instances both human and infra-human upper and lower jaws were found effectively in contact. There was the clearest testimony that the members of this part of the ancient charnel had been contemporaneous in life, as well as associated in death; and had met one common fate.



To face page 20.

CATTEDOWN CAVE

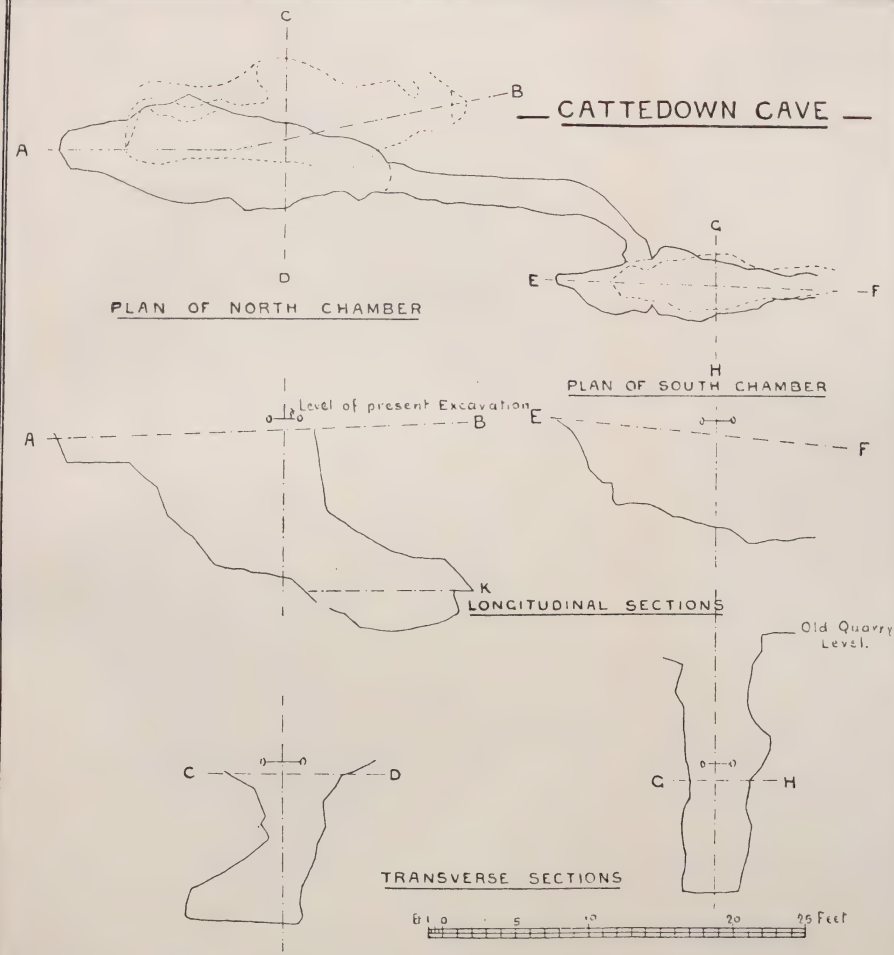
PLAN OF NORTH CHAMBER

PLAN OF SOUTH CHAMBER

LONGITUDINAL SECTIONS

TRANSVERSE SECTIONS

SCALE.



When we speculate upon the manner in which the remains of the breccia found their way into the cavern, one hypothesis may at once be discarded. The cavity was not an open fissure, into which the animals might have fallen from the surface. Again, the bulk of the remains were those of animals which have nothing naturally to do with caves, and whose bodies must have been brought there by some agency external to themselves.

There are three ways in which their presence may be accounted for. They may have been carried or dragged into the cavern by man; or by some of the associated carnivora; or they may have been washed thither by water.

Now man would never have taken the trouble to drag beasts of chase into a subterranean larder, and throw them in a heap with carcases of beasts of prey, and the bodies of his own kith and kin: nor would he have conducted interments under such conditions.

The hyænas were the only associated carnivora capable of dragging the bodies in; but had they done so, they must have voluntarily abandoned their intended feast, or have been prevented from reaping the reward of their industry. They never willingly left fairly complete skeletons behind them. Moreover, if we admit that they dragged in the oxen and deer, we must hold that they treated the human bodies in the same manner!

There is certainly evidence that the cavern was a haunt of carnivora at the time of the deposition of the breccia. Several days before remains of the hyæna were found, the condition of some of the fragmentary bones, which appeared to bear marks of gnawing, led me to suspect the proximity of that animal. And this, together with the presence of the lower jaw of a very young hyæna cub, which had not completed the cutting of its first set of teeth, and which cannot have gone far from the place of its birth, together with the existence of a small quantity of coprolite, may be held, I think, to show that a portion of the cavern at any rate was a hyæna den.

I assume the same date and cause of deposit for all the remains in the stalagmitic-breccia. There was absolutely no difference in occurrence or condition between the human and the other bones. There was no trace of such intentional deposit of the former as must have accompanied the rudest act of burial. There was no matter of human handiwork, with the doubtful exception of

three splinters of deer horn. There had been a common end for one and all. At the same time there was unmistakable testimony that the presence of man, like that of the hyæna, was not wholly accidental. In the centre of the mass of the stalagmite of the breccia loosened by the blast, and afterwards broken, were a few fragments of charcoal. They were wholly enclosed in the stalagmite, and had all the appearance of embers of a burnt-out fire. Minute fragments of charcoal were also found in the concrete-floor, and still more in the cave-earth, at a depth of eight feet below. Hence it seems a reasonable conclusion that man as well as the hyæna must have been at least an occasional dweller in the cave.

By elimination we are brought to my third suggestion, that water was the agent of deposit. No fact was ascertained that militated against this view. The confused manner in which the bodies had been thrown together, and piled up at the end of the fissure, at once suggested a sudden rush of water.

The concrete-floor and cave-earth, on the contrary, were probably due to the action, over a lengthened period, of waters occasionally finding their way from the upper reaches of the cavern to the lower. The manner in which the remains were distributed, and their generally fragmentary character, all pointed to gradual and casual occurrence. At the same time the evident association of some of the bones here also rendered it clear that in their case at any rate there had been no re-deposition.

Further, the active causes of the formation of both deposits were immediately local. No continuous stream had flowed into or through the cavern from a distance. The most careful search revealed no single fragment of stone (with one exception, noted hereafter) foreign to the immediate neighbourhood. A few fragments of slate apart, all were limestone.

All that was required to produce the concrete-floor and cave-earth was, then, the occasional falling, and washing by the internal drainage of the cavern in rainy weather, of earth and stones and fragmentary animal remains from the higher parts of the cavern.

The remains of the stalagmitic-breccia are as readily accounted for by a sudden rush of waters, bearing with it the bodies of drowned animals, pouring into the cave, and carrying before it whatever occupants the place may have had—certainly the hyæna among the number. Nor does it require any great stretch

of imagination to believe the bulk of its human remains to be those of occupants also, since they indicate just such differences of age and sex as would be likely to exist in an ancient troglodytal family.

The last point, however, is purely a speculation, which neither adds to, nor takes from, the value of the discovery. What we have to congratulate ourselves upon is, the additional light thrown upon the human members of the cave fauna of Devon.

Before I proceed with a more detailed description of the components of the find, it may be desirable to meet some possible objections to my inferences of the antiquity of the remains, at least of the human. I have hitherto rather assumed this antiquity, than advanced categorical proof, though no step has been taken in the presentation of the case without evidence being given. I may be asked, "What evidence have you, after all, that the human remains are of equal age with those of the rhinoceros, the lion, and the hyæna—the three locally pre-historic members of the cavern fauna? May not the two sets of remains—the human and the earlier infra-human—have been associated subsequently to the original deposition of the latter? May there not be some fault in the method of investigation? Have not the investigators been deceived?"

These queries, I think, cover the whole ground of possible objection.

It has been said that the only way of obtaining absolutely satisfactory evidence from the exploration of a cavern deposit is to keep it under lock and key, and I frankly admit that in the present case nothing of the kind was done. Short of building a house over the fissure, the thing was impossible. But the cave was on enclosed premises, not accessible readily to the general public. Moreover, it was sealed by nature far more effectually than it could have been by any human lock.

Let us for a moment recapitulate the facts. We have a deposit of stalagmitic-breccia, containing not merely detached bones, but the remains of complete skeletons of various animals—deer, wolf, hyæna, and man, the principal. The association of these bones is such as to make it perfectly clear that they were deposited where found while still covered with the integuments; that is, soon

after death. They were therefore contemporaneous ; and thus we have the Cattedown man brought back, at any rate, to the era of the English hyæna. For proof that the facts were so, there are the statements of Mr. Robert Burnard and myself, that we removed many of the remains ourselves ; nay, that when the solid portion of the breccia was blasted out we were the first to examine it, and before anyone else had touched it took out not only portions of the human skeleton, but found traces of human occupation in the shape of fragments of charcoal embedded in the heart of masses of stalagmite then broken.

But we do not stop here. In the cave-earth beneath this stalagmitic-breccia, and therefore anterior to it—sealed up and inaccessible until the breccia was removed, and certainly not more recent than the era of the English hyæna—we have the remains, not merely of the hyæna, but of the rhinoceros and the cave lion, and again of man. We have thus double proof—the stalagmitic-breccia gives us evidence of the association of man with the hyæna ; the cave-earth of his association with the hyæna, rhinoceros, and lion. Is it possible then seriously to question either the integrity of the deposits when they were first opened by Mr. Burnard and myself ; or the conclusion that the human remains found are those of men and women and children who were contemporary in this country with the mammoth and rhinoceros, the lion and the hyæna ?

But for the stalagmitic seal of the breccia, which dates itself hyænnine, it might have been argued that the cave-earth was an ancient redeposit, and not necessarily contemporary. Such an objection might have been raised by a determined opponent of a hasty turn of mind. But I should have been content even in that case to argue that the presence in the cave-earth in proximity, of both humeri of what no reasonable man could question to be the same lion, and of an associated humerus and ulna of the same human subject, indicated that here also deposition took place, at least in these cases, before final integumental decay.

Something also may be held to turn on the physical condition of the bones—a point in its degree of much interest, though its importance is apt to be exaggerated. Many had been broken into minute and unidentifiable fragments. Of the remainder the bulk were light and adherent to the tongue ;

but while some were so friable as to crumble at the touch if dry, or to fall into a kind of paste if wet—and to require great care in drying—others again were fairly solid, and some really dense and hard. These differences existed between bones lying close together, parts of the same finds, and in some instances of the same animal; and it will easily be understood that bones exposed to the air continuously would be in a very different condition from others enclosed in stalagmite, or in a dense mass of clay permeated with animal matter.

Such differences were recognized from the very first by the investigators of cave deposits. Mr. W. Martyn, in 1809, stated, in his “Attempt to Establish a Knowledge of Extraneous Fossils on Scientific Principles,” that fossil bones often retained “a portion both of the gelatine and phosphoric acid in their composition, particularly in their interior parts, the surface only having undergone a privation or loss of these principles.” Dr. Buckland observed that there was less animal matter in the bones of Oreston than in those of Kirkdale.

So Mr. Clift, reporting on Mr. Whidbey’s find of 1822 (*Phil. Trans.*) at Oreston, noted that there was “a considerable difference in various specimens . . . that the loss of animal matter, and consequent decay or decomposition of fossil bones, depends very much upon the nature of the soil in which they are deposited;” and that bones of the mastodon from Ohio, and the bear from Gaylenreuth, retained their animal matter so as to keep their form when deprived of their earth by means of muriatic acid.

Analyses by Mr. Brande of rhinoceros remains found at Oreston in 1816, gave .02 of animal matter only for a bone, and .06 with water and loss for a tooth; but he remarked that he had never met with fossil bones so purely earthy. Analyses by him—of a rhinoceros tooth found at Brentford gave .04 of animal matter and water; of the tibia of a hippopotamus found at the same place, .05 of animal matter solely; while the rib of a fish from the Lyme Regis Lias contained .03. Vast as is the time, therefore, which divides us from the era of the Lias, even it has not been long enough—if time were all—to get rid of the distinctly organic constituents of the fish of the Liassic sea.

In their natural state the organic constituents of bones may be put on an average at a third, varying in the human subject from 1 to 1.6 to 1. to 2.3. In the femur of an ox Heintz gives the

animal matter at 30·58, in a sheep at 26·54; and in a human forearm at 31·11. We find the whole question of the proportion of animal matter in fossil bones summed up in *Ure* as follows: "The quantity of organic matter in fossil bones varies considerably; in some cases it is found in as large a quantity as in fresh bones, while in others it is altogether wanting. Carbonate of lime generally occurs in far larger quantity in fossil than in recent bones."

With these observations I give an analysis of a deer bone from the Cattedown breccia, very kindly made for me by Mr. Henry S. Billing, F.I.C., F.C.S.

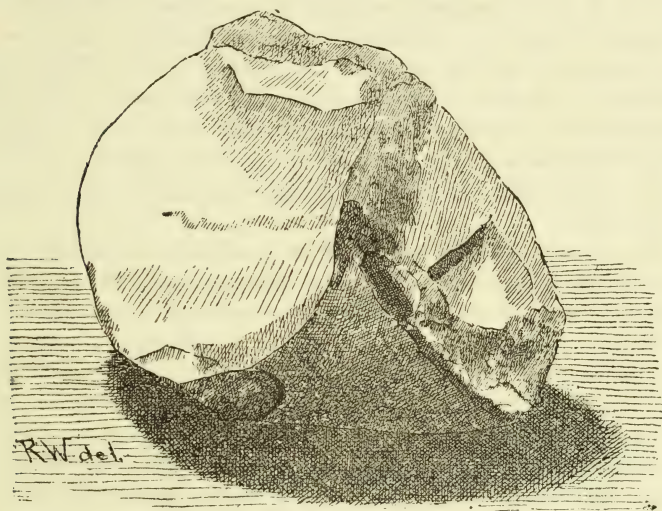
FOSSIL VERTEBRA OF DEER.						Per cent.
Ash	.	.	.	.	.	89·06
Organic matter	.	.	.	.	.	10·94
Insoluble matter	.	.	.	.	.	2·56
Phosphate of lime	.	.	.	.	.	69·43
Phosphate of magnesia	.	.	.	.	.	·71
Carbonate of lime	.	.	.	.	.	11·36

Of human handiwork there is but one certain illustration; though it is quite possible, as already hinted, that some splinters of horn found in the breccia may be artificial. On them, however, I lay no stress. The certain example is a nodule of flint, already referred to as being the only piece of foreign stone found in the course of the excavations. This nodule is white and porcellaneous in general aspect—a natural flint pebble, about a third of the mass of which has been broken off longitudinally, and a portion of one end slantwise. Flakes have been struck from it, and it also suggests a probable use as a hammer-stone, at all events in a casual way. There is no ground for doubt that the flaking is artificial; and I am glad to have the high authority of Mr. A. W. Franks, F.R.S., F.S.A., of the British Museum and Christy Collection, in support of that view. The extreme length of the nodule is 4½ inches, its extreme breadth 2¾, and its depth 2¼ inches. Originally it must have approached 6 inches in length, and 4 in depth, and have been of a flattened ovoid or discoid shape. It is partially encrusted with stalagmite. Its present appearance is shown in the annexed sketch by the finder, my son, which gives both the broken faces, and indicates the flaking on the larger.

The fauna of the cave comprises at least thirty-three species, including man, rhinoceros, lion, hyæna, wolf, fox, dog, badger, weasel, polecat, bison, urus, long-fronted ox, red-deer, roe-deer,

hog, goat, hedgehog, common bat, horse-shoe bat, mole, shrew, water-vole, field-vole, bank-vole, hare, rabbit; with various birds.

Of these the remains of man, deer, ox, hyæna, and hog were found in every part of the cave; while the wolf and fox were absent only from the southern chamber. The mole, shrew, and various voles occurred in the stalagmitic-breccia, the concrete-floor, and the cave-earth. The cave-earth yielded the lion and the rhinoceros. The badger and weasel were in the concrete-floor and the cave-earth; the hedgehog and common bat in the breccia only; the polecat and horse-shoe bat in the cave-earth. The goat



was only found in the middle and southern part of the gallery. The birds were almost wholly in the cave-earth, and in association with this also were the remains of the hare, rabbit, and dog.

Those who are acquainted with the characters of an ancient cavern fauna, will recognise that there are in this list three animals which are not usually considered to be consistent with high antiquity, to which if any of the remains assigned to the goat should belong to the sheep, we should have to add that animal also. The three are the long-fronted ox (*bos longifrons*), the so-called "Keltic shorthorn" the dog, and the rabbit. Now it is noteworthy that the remains of neither of these were found in such positions as to render their presence or absence of the

smallest importance to the argument. The bones of *bos longifrons* occurred in the loose upper deposit, which may have been part of the spoil, but neither in the cave-earth nor the breccia; and their purpose seemed to have been served when they had called attention to the possibility of further discoveries. They cannot be excluded from the list of the cavern fauna, but their relative scientific importance here is of the slightest. The rabbit and dog *are* associated with the cave-earth; but it is in connection with that part of the lower northern chamber which remained unfilled, and which, as I have said, might have been accessible to the bodies of small mammals long after it was closed to the larger. Besides, it is only recently that the wild rabbit has ceased to live at Cattedown; and we all know the capacity of that animal for finding its way into obscure recesses. Mr. Hill has told me that it used to be a favourite amusement of himself and his brothers, to put their tame rabbits into the crevices of the cliff at the back of the shipbuilding yard, and wait until they returned from their explorations.

In no instance then was there an association of ancient and modern fauna, save of an accidental character; and the evidence of the stalagmitic-breccia, and of the cave-earth proper, is intact.

The quantity of bones found in all was not less than a cartload; but only a small proportion of these, comparatively, was available for scientific purposes. Many were locked up in stalagmite; a great number were simple fragments; and of those that were clearly identifiable the smaller portion only were fairly perfect. Under these circumstances the Institution is all the more indebted to Messrs. Burnard, Lack, and Alger, that they should have placed the entire collection for selection at its disposal. With a few unimportant exceptions the whole of the human remains are now in our Museum, and every non-duplicated example also, with a large quantity of the stalagmitic-breccia.

It is not easy to take a satisfactory census of the animals whose remains were found in this ancient charnel; but among the larger deer and man preponderated; the hog and the various bovine species coming next; followed by the wolf, hyæna, fox, and badger. Of the cave-lion, rhinoceros, and polecat, so far as I am aware, these were only single representatives. The smaller mammals might be counted by the hundred; of the larger there were at least seventy or eighty individuals.

The following Table gives a view of the details of the Cattedown fauna, in comparison with the other leading ossiferous caverns of Devon, setting forth their individual characteristics, and totalling their results.

	Cattedown.	Stonehouse.	Oreston.	Yealmpton.	Brixham.	Kent's Cavern.
Man . . .	+	.	+	.	.	+
Elephant . .	.	.	+	+	+	+
Rhinoceros .	+	+	+	+	+	+
Hippopotamus	.	.	??	.	.	?
Cave Lion . .	+	.	+	.	+	+
Cat . . .	.	+	.	.	.	+
Brown Bear .	.	.	.	.	+	+
Grizzly Bear .	.	+	+	+	+	+
Cave Bear . .	.	.	+	.	+	+
Hyæna . . .	+	+	+	+	+	+
Machairodus .	.	.	.	.	.	+
Lynx . . .	.	.	.	.	.	?
Wolf . . .	+	+	+	+	.	+
Fox . . .	+	+	+	+	+	+
Dog . . .	+	+	.	.	.	+
Canis isatis .	.	.	.	.	.	?
Glutton . . .	.	.	.	+	.	+
Weasel . . .	+	.	+	+	+	+
Stoat . . .	.	.	.	.	+ A.H.	.
Polecat . . .	+	.	.	.	+	.
Hedgehog . .	+	.	.	.	.	.
Shrew . . .	+	.	.	.	+	+
Horse . . .	.	+	+	+	.	+
Ass . . .	.	.	+	.	.	.
Aurochs . . .	+	?	+	.	.	+
Urus . . .	+	+	+	OX	+	+
Bos longifrons	+	+	+	.	+	+
Irish Elk . .	.	.	?	.	.	+
Reindeer . .	.	+	.	.	+	+
Red Deer . .	+	+	+	+	+	+
Roe Deer . .	+	?	.	.	+	+
Hog . . .	+	+	+	+	.	+
Sheep or Goat	+	+	+	+	+	+
Badger . . .	+	.	.	.	+ A.H.	+
Beaver . . .	.	.	.	.	.	+
Hare . . .	+	+	+	.	+	+
Rabbit . . .	+	.	.	+	+	+
Seal . . .	.	.	.	.	.	+
Cave Pika . .	.	.	.	.	+	+
Mole . . .	+	.	.	.	.	.
Black Rat . .	+	+	.	.	.	.
Mouse . . .	+	.	rodent	+	.	+
Water Vole . .	+	.	+	+	+	+
Bank Vole . .	+	.	.	.	?	+
Field Vole . .	+	.	.	.	?	+
Bats . . .	+	.	.	+	.	+
Birds . . .	+	.	+	+	+ A.H.	+

This table has so far as possible been compiled from what may be called official documents, and includes, as far as I am aware, all the mammals whose remains have been reported from the various caves. The different finds at Oreston, Yealmpton, and at Brixham are grouped together; those of the Ash Hole in the latter place, where they are additional to the Windmill Hill, being distinguished by the letters *a h*. When there has been no distinct specific identification the common name of the genus only is given, as *ox* or *rodent*. Notes of interrogation indicate doubt. The occurrence of hippopotamus at Oreston is reported by Mr. J. C. Bellamy; for Kent's Hole it is given by Professor Owen; and Mr. Northmore gave the Museum of the Plymouth Institution portions of a jaw so identified, which, he said, came thence. Mr. Pengelly is more than doubtful of the presence of remains of this animal in Devon. The rhinoceros remains of Oreston include both the tichorhine and leptorhine species. Those of Kent's Cavern and Stonehouse are tichorhine, and so, I believe, are those of Cattedown. The hedgehog is of very rare occurrence in cave deposits, and has never been found in caverns in Devon before. The mole also is now reported apparently for the first time from our Devon caves. The bats include the common and the horse-shoe bat; and there are apparently four species of birds, of the size respectively of a swan, goose, fowl, and pigeon. This list thus gives us a certain total of 33 species from the Cattedown cave—29 of mammals, and 4 of birds. The only cave—not merely in Devon, but, so far as I am aware, in the kingdom—that is known to have been more specifically productive is Kent's Hole, with 37 certain species, and 3 doubtful, besides birds. The Brixham caves give a similar total of 26 species. The Yealmpton of 21, and the Oreston of 27; in these two cases including birds and doubtfuls. If, however, we set the Plymouth cave fauna generally against that of Torbay—Cattedown, Oreston, and Stonehouse against Kent's Hole and Brixham—the oldest cavern centre of England proves numerically as rich as its rival, even though it lacks *machairodus*; and the great find of human remains at Cattedown will serve as an excellent make-weight in that particular.

A glance at the table will show that 24 of the mammals enumerated are common both to Cattedown and Kent's Hole; that 5 are reported from Cattedown, and not in Kent's Hole; and

that 16 occur in Kent's Hole, and not at Cattedown (including doubtfuls). The great peculiarity in Cattedown is the absence of the elephant, bear, and horse, each of which has been liberally represented at Oreston and elsewhere in the vicinity. The special distinction of Kent's Hole, on the other hand, is the exclusive possession of *machairodus*, *lynx cervaria*, *canis isatis*, beaver, and seal, found nowhere else in the county, and there only in such small quantity that some such remains may very well have been overlooked in earlier explorations elsewhere. The hippopotamus, if claimable, Kent's Hole may have to share with Oreston; the wild cat it shares with Stonehouse; the glutton with Yealmpton; the reindeer with Brixham and Stonehouse; the elk probably with Oreston; the pika with Brixham. As its exclusive property, Cattedown claims the hedgehog and the mole.

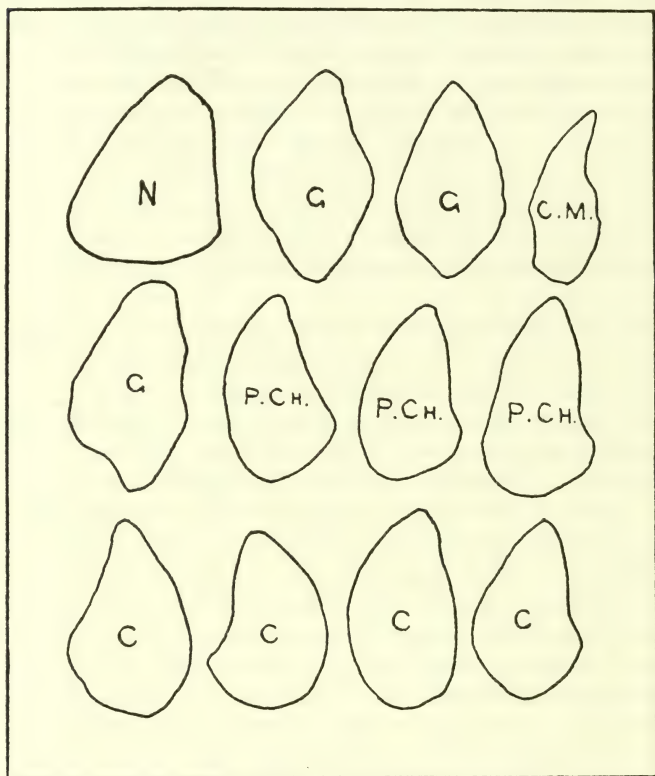
The human remains found are those of a number of individuals—at least fifteen—of both sexes, and ranging from childhood to old age. No single skeleton was complete; but every bone in the human frame, so far as I know, was represented. The most perfect portions were skulls and jaws, and bones of the extremities—the smaller especially. In this, as in other respects, the aspect of the human remains precisely resembled that of those of the lower animals with which they were associated.

The most perfect long bones are the humeri. The biggest is 11·75 inches in length; the smallest 11·2 inches, and this bone is very slender and perforated between the condyles. There is no perfect femur or tibia; but the biggest femur was probably between 15 and 16 inches, and the longest tibia 14 inches.

The most interesting point concerning the tibiæ is their markedly platynemic or flattened character, in the extent of which they closely resemble platynemic tibiæ from Perthi Chwareu in North Wales.

But likeness does not stop here. The longest of the Perthi Chwareu adult tibiæ is bigger than the longest of the Cattedown; and the least of the Cattedown is shorter than the smallest of the Welsh. Mr. Busk assigned the Perthi Chwareu bones to a race of low stature, ranging from 4 feet 10 inches to 5 feet 6 inches. Lowness of stature is also a characteristic of the Cattedown folk. The data are imperfect, but assuming the usual proportions from the dimensions of humeri and femurs, four

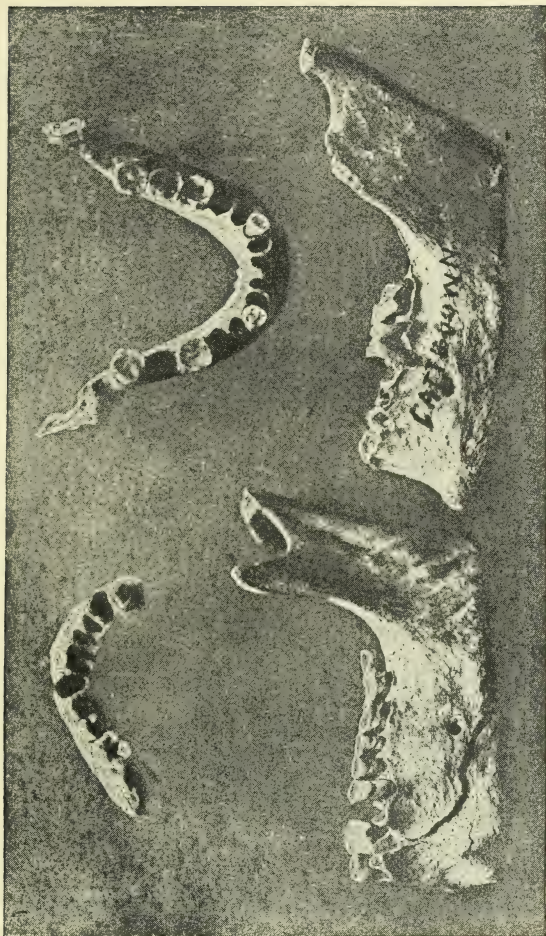
calculations work out to 4 ft. $9\frac{1}{4}$ in., 4 ft. $9\frac{1}{2}$ in., 4 ft. $9\frac{3}{4}$ in., and 5 ft. $0\frac{1}{4}$ in. respectively. And this is, at any rate, sufficient to indicate that we are dealing with a short race. Some of the bones appear to show considerable relative strength; others are



SECTIONS OF TIBIÆ.—N. Normal; G., Gibraltar Caves; C.M., Cro-Magnon man; P.CH., Perthi Chwareu; C., Cattedown.

decidedly feeble, but probably this is due to the exaggerated sexual differences of frame of early times.

Neither of the skulls could be removed intact. The most perfect were more or less embedded in stalagmite, and others were partially crushed when found. Two, however, are facially almost perfect, and one of these retains the frontal bone. Some of the detached pieces of skull are well characterized, especially



HUMAN JAWS, CATTEDOWN CAVE.

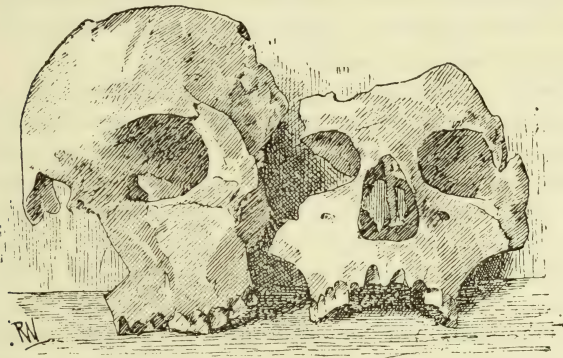


HUMAN SKULLS, CATTEDOWN CAVE.

the occipital bones. Parietal bones are also intact. Several of the skulls were exceptionally thick ; others again are very thin.

The accompanying Miesenbach plates give profiles of the two skulls, and views of four of the lower jaws. Beneath is a sketch of the skulls—full face.

So far as I am able to judge of the shape and proportions of the crania, they are neither dolichocephalic nor brachycephalic, but of a middle type—orthocephalic. They are also essentially orthognathous, and some of the lower jaws have prominent chins. The teeth are large and singularly free from traces of decay, although in many cases much worn, and the jaws in every instance give ample room for the full number.



Now as to the age of the deposits. I do not of course commit myself to any absolute chronological statement. There are no positive data for this beyond the fact that the existence of the rhinoceros and lion and hyæna in this country is pre-historic. Nor do I intend to found any argument upon such a very variable factor as the growth of stalagmite.

But there is no need to stop here. The conditions of the deposits seem to render a very considerable change of level essential to the carriage of the contents of the breccia by water in flood ; and we cannot separate them from others in the locality. In dealing with the general question in my paper on the "Bone Caves of the Plymouth District" already cited, I re-affirmed a suggestion made in an earlier paper on the Geology of Plymouth,⁶ that the deposits in the caverns at Oreston, and in the fissures on

⁶ *Plym. Inst. Trans.* v. 475.

the Hoe, generally dated back to a time "when the limestone rocks" enclosing them "were but slightly raised above the waters, and when, therefore, nothing was easier than the introduction into the caverns of bodies of animals swept down the streams, probably in time of flood." I made allowance then, however, for the possibility of some of our bone-caves turning out to be dens; and in fact I almost seem to have forecast this very cave: for I remarked, "if any of the caves were dens, the time range must have been long enough to have placed the cavities so occupied above the general reach of the waters, while the character of the fauna remained unchanged. Nay, it is quite possible that when the deposits originated, some of the caverns into which portions have since found their way, had no adequate surface communication."⁷ The exceptional conditions of the present discovery could hardly have been more carefully provided for.

I also said in 1879, and repeat now, that the period to which these remains belong "was certainly sufficiently remote to allow of the production of a present change of some hundred feet in the relative local positions of land and water, and beyond that of a pause of sufficient duration for the formation of our raised beach, with the time occupied in the continued elevation, and subsequent depression of the submerged forest." That no noteworthy change of level has taken place here in the historic period we know; and the fact that the kitchen-midden on Mount Batten isthmus, which apart from the caves gives us the earliest distinct evidence of man in this locality, has come down partially intact to the present day, shows that since its formation there can have been no material depression; and that our cave men must be very far older than their rude successors of the shore.

The point to remember in dealing with this question of antiquity, is that the Cattedown Cave is not an isolated fact, but part of a series.

So far as the evidence of date is affected by accessory points, it is decidedly in the direction of antiquity. The traces of human handiwork are, it is true, very few; but they are such as are consistent with the earliest men known to us in this country. The very paucity of those traces, it seems to me, is itself an argument in favour of age. The belongings of Neolithic man

⁷ *Op. cit.* vii. 110.

were not only less rude but more numerous than those of his Palæolithic predecessor; and I cannot imagine that Neolithic men and women could have been present in such numbers, without more examples of human handiwork being present with them; and some at least unmistakeable in assignment.

The scientific world is to be congratulated that this discovery was made upon the property of gentlemen who appreciated its importance, and at their own expense carried out the works necessary for its elucidation. Our heartiest thanks are due to Messrs. Burnard, Lack, and Alger for their interest and liberality; and to Mr. Robert Burnard in particular for his ceaseless supervision, and his determination that whatever was needed to be done should be done, and that thoroughly. To Mr. Tweedy and Mr. Roy I am also greatly indebted for photographs of the cave and some of its contents; to Mr. Davies, F.G.S., late of the British Museum, for very kindly naming a number of the infra-human bones; to Mr. G. Jackson, F.R.C.S., for his valued assistance in dealing with the relics of man; and to Mr. Billing, F.C.S., for his analysis of some of the bones. My son, besides preparing the very careful and accurate plan of the cave, has assisted me in various other ways. The lower jaws are reproduced from a photograph by him; and the drawings generally are his also.

In conclusion may I remark that in the Museum at Leeds, attached to a collection of Oreston bones, there is a label which sets forth with regret that no attempt had been made "to explore the caverns [of Oreston] systematically, or under scientific superintendence." I might demur to that statement as it stands, and up to the date covered, if it is to be taken in its full, literal, significance; but I am content to point to the Cattedown Cave and its results, as proof that we are wiser now; and that when we in Plymouth get hold of a good thing in the cave line, we are quite ready and able to deal with it.

I append a list of the most interesting features of the human relics:

1. Skull, with left side of face intact, the frontal bones over both orbits; and the right maxillary detached. The jaw, forehead, and left orbit are complete, with the right brow, and the lower part of the nasal orifice. This came from the outer part of

the stalagmitic breccia, and the teeth are partly encrusted with stalagmite. Extreme height from teeth to crown, 6·25 inches; extreme breadth on the interzygomatic line (arrived at by doubling the perfect half) 5 inches; between the outer rims of the orbits 4·25 inches. Breadth of orbit, 1·63 inches; height, 1·25 inches. Breadth of nose at base, ·81 inch; height from base to suture, 1·96 inches. The brow is strongly marked, the forehead receding. The height from the upper rim of the orbit to the crown as preserved is 3 inches; length of the face, 2·64 inches; length of upper lip to edge of alveolus, 1·06 inches. Distance from the lower rim of the orbit to the edge of the alveolus, 1·64 inches. The left maxillary contains five teeth—the three molars and two bicuspid (wholly or partially encrusted with stalagmite), with the sockets of the canine and of two incisors. The first bicuspid displays a remarkable abnormal feature. The fang has pierced the jaw, and grown outside it for a third of its total length of one inch. The right maxillary contains the three molars, first bicuspid, and four sockets. The molars are strongly tubercular, and show no appreciable signs of wear; and the skull is evidently that of a person in early maturity. The full breadth at the back of the jaw is 2·5 inches.

2. Skull (the first found—in loose, outer breccia), with upper jaw intact; the left orbit, nasal orifice, and a portion of the right orbit. Of the frontal bone the brow only remains. The breadth over nasal suture does not seem to have exceeded 4·5 inches; length of face, 2·5 inches. Breadth of orbit, 1·44 inches; height, 1·38 inches. Height of nose, 1·7 inches; breadth, ·96 inch. The orbit lies rather low; the distance between its lower rim and the edge of the alveolus being 1·56 inches, and having the appearance of being still less. Length of upper lip to edge of alveolus, 1·125 inches.

The jaw is 2·25 inches in breadth at the back, and contains ten teeth, much worn, not flattened, but sloping from within outwards. Those wanting are the canines and incisors. The skull is that of a person of mature years, probably a woman.

3. Skull at base of stalagmitic breccia, four feet from inner end of northern chamber (marked C A). Of this only pieces could be preserved, including fragment of right ramus of lower jaw; with first and second molars, a little worn, two sockets, and remains of two more: external depth of jaw, with teeth, 1·5 inches; without,

1.125 inches. Second fragment of lower jaw with canine. Small fragment of maxillary, also with one tooth. Several small portions of cranium.

4. Calvaria embedded in stalagmite, found in the stalagmitic breccia after the blast; probably a part of the same skull to which belonged one fragment of lower jaw with two molars, fairly worn, and two fragments of upper with one tooth, taken out by myself immediately after the hole was fired. Marked C B.

5. Portions of upper and lower jaws found in the stalagmitic-breccia on the level of the concrete-floor, at extreme back of northern chamber, seven feet below the stalagmitic-floor covering the breccia. The upper jaw is represented by a portion of the right maxillary, containing two molars, two bicuspid, the socket of a canine and that of one incisor. The lower jaw by a portion of the right ramus, containing the first and second molars, and the socket of the first bicuspid. The second bicuspid was lost during life, and the bone has closed in; the socket of the first rises to a level with the surface of the molars. This may have arisen from the absence of the corresponding teeth in the upper jaw. If natural, it is the strangest feature of the find. This is a very massive jaw, and the curvature approaches closely to that given for the Australian type in Professor Owen's *Odontography*. The chin was evidently very prominent. The teeth are big and worn. Marked C C.

6. Portion of right maxillary with five teeth. Two fragments of right ramus of mandible with four teeth. These appear to belong to the same individual; the teeth, little worn, are precisely of the same character, and in the same condition.

7. Upper jaw in two portions, with very tubercular teeth, little worn. Right maxillary contains two molars and five sockets; left maxillary (which comprises a portion of the nasal orifice) one molar and six sockets.

8. Upper jaw in three portions. Left maxillary in two pieces with four teeth and three sockets; right maxillary with four teeth and two sockets. Teeth tubercular, unworn.

9. Right maxillary with four teeth and three sockets.

10. Left maxillary (not correspondent to the preceding) with one tooth very much worn, and remains of six sockets.

11. Portion of right maxillary embedded in stalagmite from breccia.

12. Lower jaw, perfect with the exception of right condyle and portion of ramus adjacent. Contains all the sockets, but only two teeth, much worn on an outward slant. The broken fangs of right canine and bicuspid are left in their sockets. Massive angular chin; slanting ramus, 1.75 inches broad; depth at symphysis, 1.25 inches. This was the first jaw found.

13. Lower jaw, perfect with exception of the condyles. Contains seven teeth, with both canines; much worn. Interangular breadth, 3.5 inches; depth at symphysis, 1.125 inches. Chin somewhat rounded. Corresponds very closely in character with No. 2.

14. Portions of mandible from first right bicuspid to second left molar. Contains four teeth, with sockets of incisors and canines. Jaw thick but not deep.

15. Left ramus of mandible, with condyle and six teeth worn flat, and two sockets; lower front margin absent. Extreme depth from top of condyle, 2.75 inches; extreme breadth of ramus, 1.5 inches. Also portion of right ramus, with one tooth and five sockets; depth at symphysis, 1.18 inches.

16. Germs of two deciduous molars.

17. Upwards of seventy loose teeth, the majority of which cannot be connected with the fragments of jaws enumerated. In the concrete-floor twenty-eight were found, representing at least three individuals—one set large, and little worn, including canine 1.06 in length; another much worn; and a third small and much worn. Teeth were found in every part of the cave, in something approaching the same proportion to the remains of other animals. They are chiefly of a massive character, and, however much worn, show hardly a single trace of decay.

The jaws give ample room in every instance for the full number of teeth, and in the majority of cases the canines are prominent.

THE BOROUGH OF PLYMPTON ERLE.

SYLLABUS OF LECTURE BY J. BROOKING ROWE, F.S.A.

(Read 27th October, 1887.)

THE lecturer traced the history of the Borough from the earliest times, and referred to the various Charters granted—from that of Baldwin in 1242, the oldest of which there is any knowledge, down to the last, that of William and Mary. Reference was also made to the Parliamentary Representation, and the distinguished men who had been connected with the town from time to time.

THE DRAMA.

SYLLABUS OF LECTURE BY WILLIAM GREENLAW.

(Read 3rd November, 1887.)

ANCIENT drama: religious origin. The three Greek masters. Greek the source of European drama. English drama self-developed. Renaissance. Elizabethan dramatists. Shakespere. The unities. Classic and romantic drama contrasted. Restoration dramatists. Puritan hostility. David Garrick. Macready. Contemporary drama. Abuses. Conclusion.

THOMAS À BECKET.

SYLLABUS OF LECTURE BY F. J. WEBB, F.G.S.

(Read 10th November, 1887.)

HENRY II. and Becket: a contrast. Birth. Early life. Education. Theobald's favour. Diplomatic services. Chancellor.

The courtier. Church *v.* State. Archbishop. Pluralism. Incompatibility of the two offices and resignation of Chancellorship. Council of Tours. Results. Henry and the clergy. The Anglo-Saxon courts. Separation of ecclesiastical from civil courts. Council at Westminster. Council at Clarendon. Attempts at escape. Parliament or Great Council at Northampton. Sentence and appeal to Rome. Escape to the Continent. Proceedings of Henry at home and Becket abroad. Becket appeals to Henry and to the bishops. Attempts at reconciliation. Coronation of the young prince and excommunication of all who took part. Henry visits Normandy. Reconciliation effected; advantageous to Becket and discreditable to Henry. Excommunications. Interdicts. Becket's return. High-handed proceedings. Archbishop of York appeals to Henry. Henry's passionate utterance. Becket's murder. Escape of the murderers. Henry's anxiety. Henry's submission to the Pope and expiation. Review and summary.

THE RACE AND THE NATION;

OR, THE ELEMENTS OF TRUE NATIONALITY.

SYLLABUS OF LECTURE BY REV. J. ERSKINE RISK, M.A.

(Read 17th November, 1887.)

NATIONALITY a modern idea. Only cities, states, empires in antiquity. The Roman empire the nearest approach to the modern idea of a nation. What is a nation—its true elements? (1) Race? (2) Language? (3) Religion? (4) Common interests? (5) Geographical distinctions? If not these, what remains? The man himself and his necessities. A spiritual family, so to speak. Nationality the result of a truly national will; in other words, a unanimous and spontaneous expression of the people's will. Two selected instances to test the principle. Concluding with the poetess's aspirations, "even after death," for her people's acknowledged nationality.

SOME PRESENT-DAY EVIDENCE FOR THE RICARDO THEORY OF RENT.

SYLLABUS OF LECTURE BY D. D. DOBELL.

(Read 24th November, 1887.)

How economic rent is a genus made by mental abstraction, as regards a quality or attribute which many things otherwise different have in common. Ground rents, dead rents, royalties and other rents derived from land, mines, quarries, advertising stations, copyrights, patents, genius, referred to and differentiated. Margin of cultivation, how dependent on costliest produce yielding *no* rent; and how the costliest produce fixes the natural value, and approximately the price, of produce obtained under better circumstances where there *is* rent marking the advantage. Instances of how rents and the margin of cultivation are affected by international trade and prices. Falling rents. The reclamation of waste lands. The sense of private property.

DISCUSSION ON DARTMOOR.

W. GAGE TWEEDY, B.A.

(1st December, 1887.)

A DISCUSSION on Dartmoor was introduced by Mr. W. Gage Tweedy, who divided his subject into the following heads, each of which was separately treated, so far as time allowed. Concerning its *Antiquities*: Roads and bridges; pounds and enclosures; remains of buildings; kistvaens and cromlechs; rock-basins and logging-stones; mines and streamings; blowing-houses; tools and weapons; boundary-stones; crosses and lych-stones.

In the course of the discussion interesting particulars concerning the old roads and bridges, ancient buildings, pounds, and enclosures, cromlechs, rock basins, and logging-stones were given, and a greater variety of information perhaps elicited than could have been conveyed in a set lecture. The discussion of other points was adjourned to a future occasion.

VITTORE PISANO, MEDALLIST.

SYLLABUS OF LECTURE BY J. SHELLY.

(Read 8th December, 1887.)

VITTORE PISANO (called Pisanello), of Verona, born about 1380, died probably in 1451. Famous among his contemporaries as a painter. Painted frescoes at Verona, Venice, and Rome; also panel pictures, of which there is one in the National Gallery. Entitled to a place in the history of art chiefly as a medallist. His medals the earliest and among the finest of modern medals. The medallists of Italy, Germany, France, and England. Pisano's medals and those of the fifteenth century generally are cast, and not struck. Later medals are struck. Difference of character and style. Subjects of Pisano's twenty-four extant medals. The Estensi, Malatesti, and Gonzaghi, and Alfonso V. of Arragon. The art of the Renaissance. The age of the despots. The value of the medals as works of art. The sphere and limitations of medallic art. Principles of design and composition illustrated by the medals. Pisano's medals compared with more recent works. The jubilee coinage and jubilee medal.

The lecture was illustrated by drawings and photographs, and by casts from the original medals in the British Museum.

GRATTAN'S PARLIAMENT.

SYLLABUS OF LECTURE BY GILBERT SLATER, B.A.

(Read 15th December, 1887.)

ORIGIN and early development of the Irish Parliament. Ireland under the Tudors and Stuarts. Penal laws and commercial disabilities. The land question in the eighteenth century. Manners and customs. Whiteboys. Smuggling. The Irish squireen. Rise of national feeling.

HOME ARTS AND INDUSTRIES.

ABSTRACT OF LECTURE BY JOHN PHILLIPS.

(Read 22nd December, 1887.)

WHILE much is being said in this country about work for the unemployed, other countries are doing for us work that we might well do for ourselves, thus taking money out of the country that we sorely need.

The Governments of other countries organize new industries for their people. English enterprise should be sufficient to enable English people to follow the example of foreign Governments. To some small extent this has already been done. *How* to do it has been well shown by Mrs. Ernest Hart, and the Donegal Fund.

The work of the "Home Arts and Industries Association" is preparing the way. Their system of training educates the members of their classes for "supplemental" employments; these classes constitute in fact "continuation schools."

Through this Association it is perfectly demonstrated that English workers are no less apt scholars in art training than those of other countries. Work is *now* being produced in the minor arts that meets in quality and price the imported article, and yields increased earnings to an increased number of producers. The development of *new* industries, and the revival of old ones in country districts, will be greatly assisted by the practical application of recent scientific discoveries, in regard to the distribution of motive power, through the agency of electricity and of compressed air. A central station on the banks of a river where now the water runs to waste, could generate sufficient power to supply surrounding villages.

The import of articles in metal, wood, pottery, and textile fabrics is very large, and the trade in such goods with the colonies increasing. The supply of this increasing demand can be readily

met in this country. The opening up of village industries arrests the flow of rural labour into the already overcrowded towns and cities. The trained artizan may follow his calling amid healthy surroundings, and vary his work in his garden allotment. Increased labour thus comes to the land, and the production of home-grown feeding stuffs is increased.

Government aid has secured the allotment, but should be further avoided as far as possible. The need alone remains that the work of the Home Art Association should be supplemented by organized work set forth by business men; care must be taken that the capabilities of localities are duly considered, then a wide field opens for the profitable employment of capital as well as of labour.

The distribution in English country places of money now paid out of the country for what can quite as well be produced *in* the country, in itself creates additional work and employment.

The two hundred or more classes of the Home Art Association show not only the aptitude of English lads for the art work attempted, but the readiness, nay eagerness, with which they take it up.

Mr. Charles G. Leland, of Philadelphia, in the *Circular of Information* issued by the United States Government (No. 4), says, "The system on which this industrial art work should be taught is, the learning how to design the patterns, and then working them out in any material, such as wood, clay, brass, embroidery stuffs, &c. There are fifty or a hundred such minor arts, and any body who can draw or design can, with very little practice, in a few days execute them fairly in any substance which will retain impressions. It is a remarkable law of nature or of humanity, that all the minor arts, or such branches of industry as are allied to ornament, are very easy, and can generally be so far mastered in a day, by anybody who can draw, as to enable the pupil to produce a perfectly encouraging result.

"What is wanted is simply large sheets in the large outline designs of different kinds of art industry work. Let me illustrate this by a single instance. In many parts of America boards even of oak, walnut, or more valuable woods are cheap enough, and men who can manage saws and planes are not wanting. These

people are often without furniture, and pay extravagant prices for the flimsy, worthless, ugly, glued-together, and varnished trash of the factories. Now there is a type and style of very elegant solid furniture, such as was made in South Germany for centuries, which would cost no more than the glued and veneered trash. It is made by simply sawing, boring, and pinning or bolting planks or boards together. Any man of ordinary intelligence, having the design for a table or chair of this kind before him, can take the measurements and make it.

“Industrial art is rapidly becoming in education and in life as essential as reading or writing. There are millions of people in America whose homes, on which much money has been spent, are not really creditable, good-looking, nor comfortable. They would all have tasteful or artistic and cheap adornment if they could get it.

“The best characteristic is the impression of individual character. This disappears in the machine; in fact, the more perfect machine-work is the less is it artistic. The faultlessly-finished piece of silver-work, such as no mere smith could ever rival, shows indeed the result of ingenuity, but not of art. A Soudan bracelet, made with a stone and nail, is far more artistic than a Connecticut mill-manufactured dollar bangle, yet the latter is infinitely the more ‘finished’ of the two.

“I am sure that Industrial Art introduced into elementary education will go far to make children love school. In England rural clergymen and their wives soon saw into this; and Mrs. Jebb, of Ellesmere, was the first to establish village art schools.”

What Mr. Leland writes on this subject is entitled to every consideration. He has put to the *proof* his system of training the young in industrial art. The authorities in Philadelphia afforded him every facility in the public schools, and he achieved complete success. The Bureau of Education of the United States usually issue about 14,000 of the *Circulars of Information*. Of No. 4 (1882)—Mr. Leland’s quoted above—they issued and distributed 60,000, with the result that drawing and its application to art industry has been introduced into hundreds of schools.

Specimens of work from various classes were shown. Leather decoration and pottery from Kirkby Lonsdale; pottery from Chalfont and Castle Headingham; brasswork from Keswick; carved wood from Ellesmere and Yattenden; linen—spun, woven,

and embroidered—from Langdale and Donegal ; wood, brass, iron, and mosaic-work and decorated pottery from the Abbotskerswell and Kingskerswell Cottage Classes.

NOTE BY THE LECTURER.—Since the above paper was read I have been favoured with some information respecting the Sloyd system of education, as practised in Sweden, Norway, and Denmark. It comprises simple metalwork, smithwork, basket-making, painting, trade fretwork, needlework, carpentry, carving and turning. The Sloyd system is spread over Scandinavia and Finland, and is taught even within the Arctic Circle. In Sweden alone wood Sloyd is practised in 800 national schools, has been introduced into secondary schools for boys, and is now being adopted even in the upper schools for girls. It has also been introduced into France, Belgium, Germany, Austria, Russia, and the United States, and is about to be taken up in Abyssinia, through the instrumentality of the Swedish missionaries. Herr Abrahamson, a wealthy Gottenberg merchant, founded in 1872, in memory of his wife, a Slöjd (Sloyd) seminary, on his estate between Stockholm and Gottenburg, for the training of teachers in the various branches of instruction that the Sloyd system promotes.

CONVERSAZIONE.

(5th January, 1888.)

AN account of the proceedings will be found in the
Report of the Secretaries.

THE OBER-AMMERGAU PASSION PLAY, 1880.

BY REV. W. BINNS.

(Read 12th January, 1888.)

PRE-ORGANIC EVOLUTION.

BY REV. PROFESSOR CHAPMAN, LL.D.

(Read 19th January, 1888.)

EGGS OF FISHES AND THEIR DEVELOPMENT.

SYLLABUS OF PAPER BY J. T. CUNNINGHAM, B.A., F.R.S.E.

(Read 26th January, 1888.)

(1) DESCRIPTION of the egg of a particular species taken as type. Example chosen, the whiting. (*a*) The discharge of the egg or ovum from the parent fish at the annual spawning time. (*b*) The process of fertilization and the changes which accompany it.

(2) The process of development in ova. (*a*) The formation of the blastodisc and the segmentation. (*b*) The blastoderm and the periblast. (*c*) The process of invagination and its immediate results. (*d*) The growth of the blastoderm over the yolk, with the consequent elongation of the embryonic rudiment. (*e*) The early development of the principal organs during the above process. (*f*) Growth of the embryo subsequent to the envelopment of the yolk; formation of the tail and the fins. (*g*) Hatching; the characters of the larva, and its gradual growth into the young whiting.

(3) Comparison of the ovum of fishes with those of other animals. (*a*) The essential or primary features of the ovum. (*b*) The secondary features peculiar to particular classes.

(4) Origin of the ovum. (*a*) The ovary, its essential and its secondary structures. (*b*) The ovary of fishes compared with those of other animals.

(5) Comparison of the ovum of the whiting with those of other fishes. (*a*) Differences in fish-eggs in external surroundings. (*b*) Differences in internal structure. (*c*) Differences in the larvæ at time of hatching.

(6) The craft of pisciculture founded on the science of fish-development. (*a*) So-called artificial fertilization. (*b*) Control of the eggs during development.

THE HERRING FISHERY.

LECTURE BY B. J. RIDGE.

(Read February 2nd, 1887.)

For the political economist fish may be considered from two separate, though practically united standpoints; viz., those of food and of commerce. As an article of diet, recent investigations have clearly shown that many fish contain as much solid matter as lean beef; and that the herring contains between twenty-four and thirty-one per cent. of solid matter, and is therefore very often more solid than lean beef. As a matter of commerce, the supply of sea fish being practically inexhaustible, the importance of our fisheries can hardly be overestimated. The fecundity of fish is simply marvellous. Thus the roe of a crayfish contains 3,000,000 eggs; ling, 19,000,000; sole, 1,000,000; mackerel, 500,000, and of a herring, 32,000; while herrings spawn more than once a year.

The Herring Fishery is among the most important, if it be not itself the most important, of the fisheries of Great Britain, alike as regards the number of men and boys engaged and the amount of capital invested. And it must not be forgotten that it requires considerable hard and intelligent labour, seeing also that it gives employment directly to so great a number in the building and repairing of the boats and their equipments, as well as in delivering the fish to the consumer.

The herring belongs to the family *Clupeidæ*, of which the shad (*Clupea finta*), pilchard (*Clupea pilchardus*), and sprat (*Clupea sprattus*) are members. There seems to have been no systematic and detailed description of its anatomy till recently. This has been given by Mr. J. Duncan Matthews, who during 1886 prepared a paper referring principally to the skeleton, and for obvious reasons chose the British herring as the type to be described in detail.

The vertebral column of the herring consists of a variable number of vertebræ, generally 56 to 58. For the shad Day records 55 to 56 vertebræ, Dr. Gunther, 56; ribs, 36. The vertebræ of the pilchard number about 52 (Day gives 50; Gunther, 53; Lowe, 50 to 51), with 32 ribs. In the sprat the vertebral column consists of only 48 vertebræ, and the ribs number 28 in all.

The vomer in the sprat has a short central ridge on it, but no teeth; whilst on the vomer of the herring there is an ovate patch of teeth: this, taken in consideration with the difference in the number of vertebræ, and the number of the ribs, may be considered sufficient to prove satisfactorily that the sprat is not the young of the herring, as has often been thought.

In very early times fishing for herrings was practised by the dwellers on our shores, especially on the east coast. The Romans considered the herring a very dainty dish. In the records of the Abbey of Evesham, founded early in the eighth century, there are several references to the Herring Fishery, which shows conclusively that herrings in those days were widely used and much valued. As Evesham is situated in the midland county of Worcestershire, it is only reasonable to suppose that these fish were obtained from Yarmouth. A notice in *Domesday* too goes to prove that its Herring Fishery made Yarmouth so important a place.

The fishery continued to increase at Yarmouth, and became so extensive that, in the reign of William II., William Herbert de Losinga, bishop of Norwich, built upon the sand there a chapel, and placed therein a godly minister, whose duty it was to say divine service, and to pray for the health and success of the fishermen that came to fish in the herring season. Henry I., in 1109, appointed a provost to collect the king's customs at Yarmouth, owing to the great concourse of fishermen, traders, and merchants from every part of England and Flanders and Normandy. In 1199 Dunwich was erected into a free burgh, on payment amongst other items of an annual tax of 2400 herrings.

Salt in curing herrings must have been early used, or they could not have been widely distributed. So far back as 1041 there existed at Gorleston, at the entrance to the Yare, next

to Yarmouth, three salt pans. Henry III., in 1242, purchased of the men of Yarmouth, for distribution in alms, herrings to the value of £50 (equal to about £750 of present day currency), which shows that the herring was not lightly esteemed then, and was gradually increasing in favour.

In the fourteenth century Great Yarmouth possessed no less than 250 fishing boats; and for the purpose of fostering and promoting the Herring Fishery the famous Act of Parliament, known as the "Statute of Herrings," was enacted, which regulated the amount of profit the merchant should get on the last of herrings, and other matters relating to the selling and buying and curing of the fish.

During the Commonwealth very little attention was paid to the Herring Fishery. But in the reign of Charles II., in 1661, an Act was passed prohibiting the Dutch and French from selling herrings in England. No considerable increase, however, took place in the Herring Fishery during the seventeenth century.

The Dutch possessed at that time a very considerable fleet of herring boats, numbering 1500 craft of about eighty tons burthen, and had no less than twenty men of war to protect them. At the commencement of the eighteenth century, when war broke out between France and Holland, and when the Dutch herring fleet was only guarded by four ships of war, the French attacked them, and destroyed no less than four hundred of the largest of the Dutch boats—a serious blow to the supremacy of the Dutch Fishery which has never been recovered.

During the latter part of the eighteenth century, our Government gave large bounties to the English and Scotch fishermen, and boat owners, and something like £316,365 was paid to Scotland, but the amount paid to English fishermen and boat owners has been kept a profound secret. At that time the Swedish Herring Fishery was of considerable importance, and strongly competed with our own fishermen.

During the present century, and especially during the past thirty years, England and Scotland have far outstripped other nations in this important industry; and the Scotch are now by far the greatest herring fishers in the world.

The Herring Fishery is carried on by two distinct methods; by the Drift Net, and by what is curiously called Trawling,

which is properly seining. In a few instances moored nets are used, but not to any large extent.

Drifting is the principal method. The length and depth of the net, and also the size of the mesh, are not quite uniform. Fishermen from different parts, both in England and Scotland, act on their own judgment in this particular. The Scotchmen generally have their net braided 60 yards long, and about 350 to 400 meshes deep, 32 to 40 meshes to the yard.

On the east coast of England, among Yarmouth and Lowestoft fishermen, the ordinary net is from 18 to 22 yards on the rope—that is after it is fixed to what is called the back rope, having usually 280 to 240 meshes in depth, 30 meshes to the yard. In the West of England, among the Devon and Cornwall fishermen, the herring net is more akin to the Scotch nets.

The number of nets used depends on the size of the boats. From 40 to 60 nets are used among the Scotch men, whilst the Yarmouth and Lowestoft boats carry from 120 to 180 nets, so that 140 may be considered a fair average. The nets are all made of cotton, though formerly hemp was commonly in use.

The nets are attached together by stops up and down the selvage, and by stops at the ends of the back rope, secured along the top to the back rope by a nozzle or nossal. Along the back line, or head line, pieces of cork are attached. To the back line again large bowls and buoys are secured at certain regular distances, to keep the net from sinking deeper than is required. The whole is then secured by pieces of rope called stops, or straps, fastened to the back line by one end, the other part being fastened to the foot-rope or warp.

The warp is principally used for hauling the nets on board, and runs along the whole length of the nets. The outer end of the warp is fastened to the first net put over the boat's side, and is simultaneously put into the sea with the nets, and so fastened by these stops, as net after net is being shot. When the entire fleet is out, the boat is secured by the rope to the nets; and the boat, with the nets, is allowed to drive by tide and wind whither she will, till the skipper in his judgment gives orders to get the nets on board.

Generally, as the nets are being hauled on board, the fish are shook out, and allowed to drop into the hold of the boat, called the fish-room; and according to circumstances, incidental to the

season, they are brought to land daily in a fresh state, or are salted on board; and when, in the judgment of the crew, they have a sufficient quantity, they return to port for the purpose of turning them into money.

At present the Herring Fishery may be considered to be prosecuted all the year round at some part or other of the coast.

The principal season, however, is during the summer months—May, June, July, and August in Scotland, and August, September, October, November, to part of December in England—though there is an important fishing going on on the east coast of England during March, April, and May, and sometimes in June; whilst again in Scotland herrings are fished for in January and February. The great summer fishing in Scotland is prosecuted by no less than 7000 boats, and gives employment to 64,387 persons.

The west coast of Scotland fishing embraces nine districts—Stornoway, Loch Broom, Loch Carron and Skye, Fort William, Campbeltown, Inverary, Rothesay, Greenock, and Ballantrae—and had no less than 169,783 barrels cured in 1886 (in 1885, 253,969), 2,989 boats being engaged.

In the Orkney district, the Orkney Islands and Strona in the Pentland Firth, 168 boats were engaged. Fishing began July 13th, and finished in August. 18,949 barrels were cured. Through the year previous 53,300 barrels were obtained. Stormy weather and low prices are the chief causes of the season's decrease, as it was not prosecuted with the usual perseverance at the beginning of the season.

In the Shetland district there were 840 boats—504 at Lerwick, and 336 in the Unst section. This fleet comprised 400 boats belonging to the district, and the remaining 440 were from the Isle of Man, and east coast of Scotland. 198,051 barrels were cured (370,238 in 1885), but an increase on the previous ten years of 78,468 barrels. In the history of the Herring Fishery of Scotland, nothing is so striking as the increase in Shetland in recent times; for in the year 1874, 1180 barrels were cured, whilst in 1885, as we see, no less than 370,238 were secured.

The east coast fishing takes in the following districts—Eyemouth, Leith, Anstruther, Montrose, Stonehaven, Aberdeen, Peterhead, Fraserburgh, Banff, Buckie, Findhorn, Cromarty, Helmsdale, Lybster, and Wick, and here 925,439 barrels were

cured during the year. This gives a grand total of 1,312,223 $\frac{1}{4}$ barrels, a result so important to be worth the attention of any political economist, and demanding the careful consideration of any Government.

It will at once be seen that to carry on so great an undertaking as the curing of these fish for exportation, requires both large capital, and extensive plant, and some arrangement to prevent any sudden break down, which probably would occur if the matter of buying the catches on boats arriving daily at their respective stations were not duly considered. Curers, therefore, arrange generally with crews to fish during the season; and this is done on a price agreed upon some months before the fishing commences, at per cran, and not as in England at per hundred, or thousand, or last.

The cran is a standard measure of the Scotch Fishing Board, and contains about thirty-eight gallons. The advantage of using the cran is, that the fish are more quickly delivered, and the question of the size in no way affects the matter of the price. It has been the custom among curers for some years past, previous to the last two years, to give the fishermen a bounty of from £10 to £40, plus the price per cran, which was generally paid on arrival at the fishing station. The settlement of the season's fishing generally is left till the finish of the voyage, and this peculiarity of the engagement system has its risky element. It often happens that the curer comes to grief before the fishing is over, or even after he has exported his season's cure; and that through bad markets, or from the poor quality of the herrings at times, he cannot realize the cost, and has to make other arrangements as best he can with the fishermen, who have to put up with the loss.

Another feature in the Scotch herring-curing is the branding of barrels of cured fish by officers appointed by the Scotch Fishery Board. The full herrings are branded "Crown Fulls;" then come "Maties," being between a large full herring and the third class—"Spent" fish; whilst again another selection is made as "T. B.," or "Torn Bellies." Hence there are four distinct brands. This gives some guarantee for careful selection and packing, but is only used in connection with the export trade.

In preparing the herrings for the Baltic ports (Russia and Prussia) every fish is gutted by cutting the throat and taking

away the gills and pulling the entrails out at the same time. It requires no little skill to perform this operation successfully, so as not to injure the insides. They are then well soused in salt and carefully packed in barrels, back downwards, tier upon tier, and salted, allowed to settle, and refilled till quite full and tightly packed. Then they are headed and well coopered up. Women are engaged for gutting and packing. At some of the stations (at Stornoway, for instance) curing herrings for home markets is done, and the kippering of herrings is carried on to a considerable extent.

Not only is the Herring Fishery prosecuted for the export trade, but our home markets are supplied with fresh herrings from Scotland. But the question of railway rates seriously affects its development; and it often happens that the cost of transit swallows up the proceeds of the sale, and the sender gets nothing for his outlay, which in turn affects the fishermen.

The total number of boats engaged in the various sea fisheries of Scotland is no less than 15,344. Those engaged in the pursuit number :

Fishermen and boys	.	.	.	.	48,919
Fish curers	.	.	.	.	1,073
Coopers	.	.	.	.	2,697
Other persons, estimated	.	.	.	.	44,206
Total	.	.	.	.	<u>96,895</u>

The capital invested is as follows : Boats, beam and trawl vessels, £916,017 ; nets, £756,579 ; lines, £122,361 ; total, £1,794,957. To this I may add that the gross total value of the sea and salmon fisheries of Scotland in 1886 was £2,550,778 8s. 3d.

The east coast is the home of our English Herring Fishery, Great Yarmouth and Lowestoft being the two principal ports, whence yearly no less than 700 very superior fishing boats engage in this prolific sea fishing, with at least 9000 men and boys on board. In rig and build these boats are very different to the typical Scotch boat, and are fitted out, both as regards fishing gear and general equipment, to contend with rougher weather.

The beginning of August is generally the time when the English boats commence the summer fishing in the North Sea—Shields, Hartlepool, Whitby, Scarborough, and Great Grimsby

being the principal ports used during August and September, when it is the custom to land the catches daily in a fresh state, though at times catches are salted at sea and disposed of accordingly at any of the respective ports, as the requirements of the trade may demand.

This fishing is principally carried on for supplying our own home markets, and, either in a fresh or salted condition, the herrings are sent daily to the centres of industry, as well as to many small towns on every line of railway in England and Wales.

Many of the Yarmouth boats during these two months—August and September—run from the fishing ground to Yarmouth with their catches, which they salt with the ordinary fishing salt, to supply the trade with bloater stuff, and also with sea-salted herrings, for those curers who export to the Mediterranean ports smoked herrings, between a bloater and a red herring, which are somewhat of a speciality in the Yarmouth herring trade.

The home or autumn fishing voyage on the east coast is carried on during October, November, and part of December, and constitutes the principal part of the Herring Fishery on this coast; for by this time the whole of the fleet belonging to Great Yarmouth and Lowestoft have returned from the various fishing grounds between the Humber and Tyne, and more or less concentrate their efforts off Yarmouth and Lowestoft.

It is noteworthy, as showing the spirit of enterprise which is now called forth in connection with this industry, that as soon as the season begins about 300 boats come from Wick, Banff, Leith, St. Monance, Montrose, Aberdeen, Pittenween, Lossiemouth, Kirkaldy, and various other parts of the east coast of Scotland, and prosecute for at least two months—October and November—this important fishery, in conjunction with their English brethren. To cope with such a large fleet of boats, especially when large shoals of fish visit the coast, and boats are bringing enormous catches, varying sometimes from twenty lasts per boat down to five lasts, special waterside market accommodation is necessary. It often happens during the very busy time of the year that no less than 400 or 600 boats are delivering their catches during the day, and it will be easily understood that a sea-frontage of sufficient dimensions to grapple with this trade is of the first importance.

Great Yarmouth provides at least one mile of quay-landing during the season, and I have often seen the whole of the river-frontage fully occupied with Yarmouth and Scotch boats delivering their catches, the result of one or two nights' fishing. And when I quote the following figures, I think you will agree that the trade done in these wily creatures is of the utmost importance as a food-supply question. There were caught in 1883, 19,355 lasts; in 1884, 23,872 lasts; in 1885, 15,793 lasts; in 1886, 21,000 lasts; in 1887, 18,346 lasts. Or an average of 19,673 lasts for the past five years, equivalent to 259,683,600 fish.

For the fishermen the price his goods fetches is, of course, a matter of no little import, and it is only reasonable that they who toil and spin and plough, though it be in ploughing the angry billows, should be able to live by their manly efforts. The depression felt in general trade and commerce did not stop short when Neptune's hosts were to be dealt with. 1886 was very disastrous to the toilers of the deep. The past season, however, was very much better, owing to various causes, quite natural in their operation. The quality of the fish was a great improvement, and the foreign markets were much better; the weather also was not so hot generally during the time the export trade was brisk. The prices during 1886 at Yarmouth averaged about £5 per last; whilst in 1887 they reached £9 per last, which enabled all concerned to just tide over the difficulties of the season preceding.

It may be interesting to note just one or two exceptional catches, which will give you some idea of the large numbers of herrings that swim in company.

The *Lily* of Yarmouth landed in one day 25½ lasts, the *Problem* 25 lasts 1 thousand, principally salted at sea. The largest single catch of fresh herrings, the result of one night's fishing, was 13 lasts by one boat, being equal to 171,600 fish.

Taking the total amount turned over in the market, and putting down the return as stated, no less than £165,114 was brought into Great Yarmouth this past season from the sea, where it is true that only reaping is done, but at times at no little loss of life and property.

Lowestoft has a tale to tell almost equal to that of Yarmouth, though not quite so extensive. By making a reduction of about

twenty-five per cent. on the total earnings, we can nearly get at the worth of this industry there, and it shows no sign of falling off.

The amount of capital invested is increasing, and the boat owners are applying the best possible mechanical appliance for developing the fishery. Steam capstans are fast replacing the ordinary manual winches for hauling the nets on board, and great improvements are taking place in boats and gear generally.

The cost of a first-class boat is £700, nets, £220, ropes, £100, bowls, £25; and the 1000 boats in the two ports thus represent a total capital of half a million.

One serious difficulty affecting the drift fishery in the North Sea, but especially off the Norfolk and Suffolk coast, is the damage to nets by foreign fishermen, principally Belgian trawling smacks, wilfully towing their trawls into the nets of our own herring fishermen, which are set at night, as it is not possible to catch herrings in the day time. So serious has this question become, that the various Governments bordering on the North Sea, and having any interest in the vexed matter, have held an international convention for better regulating the relationships between the fishermen of each nation.

Just a few words about the fishermen themselves. In general the manners, customs, modes of life, and superstitions are somewhat alike in the various villages around our coast, though the same cannot be said of the fishermen belonging to our larger fishing ports; for the same influences there have very much altered their tastes and ideas. Every fishing village has a history very much like its neighbour. From the small hamlet of say fifty years ago, each has gone through much the same development in its fisher life—from the few cottages, and few small boats, to the thriving village, and larger boats; the two have become four, and the four eight, and so on—yet, withal, maintaining many traits of originality; the old men priding themselves on their ancestry, while it is often that descendants to the sixth generation can be pointed out.

Among the Scotch particularly the surnames are somewhat remarkable, especially among the fishers of the Moray Firth, where nicknames prevail to an extraordinary extent. These nicknames have become as hereditary as the real surnames, and

very often point out personal blemishes, peculiarities of manner, &c. In most cases too the husband tacks his wife's maiden name to the end of his.

This matter of nicknames is just as noteworthy among our English fishermen as among our Scotch friends, and as prevalent in Plymouth and Cornwall as elsewhere. The peculiarity of retaining the name of the mother's side is also common among the Cornish fishermen, and is just as marked to-day as it was fifty or hundred years ago.

In the matter of religion I should say that the Scotch fishermen are more theological than the English. In fact I have heard Scotch fishermen discuss very debateable subjects, such as predestination, eternal punishment, free-will, God's sovereignty, free grace, the eternal sonship of Christ, the larger hope, inspiration of the Scriptures, baptismal regeneration, apostolical succession, the infallibility of the pope, the personality of the devil, and other knotty subjects, with an intelligence almost befitting a Professor of Divinity. They are chiefly Presbyterian, which I suppose accounts for it.

In their respective calling these men are alike brave and capable. In the hour of danger they are Britons all, as witness the valuable services they render with the lifeboats around our coast.

OBSERVATIONS ON INSECT LIFE.

SYLLABUS OF LECTURE BY G. C. BIGNELL, F.E.S.

(Read 9th February, 1888.)

THE great divisions of Entomology. Is there any advantage in the study? Is it necessary to collect insects? Do insects feel pain? A glance at the beetles, earwigs, cockroaches, caseworms, butterflies, moths, dragon-flies, ichneumons, two-winged flies, fleas, and mites.

IRISH REVOLUTIONISTS, THEIR LEADERS AND LITERATURE.

SYLLABUS OF LECTURE BY R. W. MCCARTHY.

(Read 16th February, 1888.)

THE position of the Roman Catholics when Grattan's Parliament was opened; its amelioration by that body. Dissatisfaction with partial emancipation of 1793. Vice-royalty of Lord Fitzwilliam; his recall. The United Irishmen; at first a legal society, though subsequently seditious. The Rebellion of 1798; its origin and results. The Act of Union. Robert Emmet. O'Connell's agitation. Founding of *The Nation* newspaper by Dillon, Davis, and Duffy. Formation of Young Ireland party; their aims and methods; illustrations from their writings; their estrangement from O'Connell. William Smith O'Brien. Rebellion of 1848.

THE LAKE DWELLINGS.

SYLLABUS OF LECTURE BY FRANCIS BRENT, F.S.A.

(Read 23rd February, 1888.)

INTRODUCTORY. Lake dwellings referred to by early writers. Discovery of pile dwellings in the Swiss lakes. Similar discoveries in Italy, and elsewhere in Europe. The Crannoges of Scotland and Ireland. Pile dwellings common amongst semi-civilized peoples. Pile dwellings on the Thames. Many cities built upon piles. Log huts of the backwoodsmen. No mention of lake dwellings by early Roman writers. Mode of construction of the Swiss lake dwellings. Swiss lake dwellers. Relics from the Swiss lake deposits. The three ages of stone, bronze, and iron represented thereby. Beads and nephrite. Animal and vegetable remains. No human skeletons except at one settlement. Moon images. The conclusion.

WILLIAM ROBERT HICKS, OF BODMIN.

A Memoir.

BY W. F. COLLIER.

(Read 1st March, 1888.)

ALAS, poor Yorick ! I knew him : a fellow of infinite jest, of most excellent fancy. William Robert Hicks was born in Bodmin in the year 1808, and died in Bodmin on the 5th of September, 1868; he was therefore 60 years old at his death. He was the son of a schoolmaster, and was himself a schoolmaster early in life. He was just two years older than his neighbour, Sir William Molesworth, of Pencarrow, and took his first lessons in mathematics with him. He was afterwards often to be met at Pencarrow, in the days of his infinite jest. He may be said to have been a good mathematician, as a country schoolmaster of that day, and this fact is essential to the due estimation of his remarkable character. He was a very good man of business in the performance of his various duties as Governor of the County Lunatic Asylum, which office he filled for twenty years; as Clerk to the Bodmin Board of Guardians; and as Clerk to the Highway Board—the last two offices being usually held by solicitors. Hicks was also a musician, and played the violin well enough to rank with professional players. He could take a violin part in an orchestra, as well as play ordinary drawing-room pieces.

Hicks was a very useful public man, and carried great weight with the various public bodies which he served. But he was, above all things, a humourist, and it is for his wit and fun that he will be best remembered.

He was a short, thick, fat man, much as Falstaff is represented. His face was large; he had small, bright, twinkling grey eyes; his nose was short, of the Socrates kind, the reverse of aquiline; and he had a small, expressive mouth, with a large, fat, double chin. Players pride themselves on their ability to change their

countenance. Hicks could put any variety of expression into his very changeable face; and the alteration of all his features, from a frown to a smile, in telling a story, was both astonishing and ludicrous. He was witty, could make a witty speech, a witty remark, or a witty retort; but his chief fame lay in his telling a story. He was about the best story-teller of his day, was well known as such in the two Western Counties, and established his reputation in London. He had an excellent memory, of great accuracy, and could remember every small detail of what might be said to him by an old woman; for example, the exact quaint mode of expression, the dialect, and the tone of voice, which he would mimic to perfection. There is the Devonshire dialect and the Cornish dialect, both of which he knew well. Dialects vary even from parish to parish, town to town; but I do not think there is a very marked difference between the Devonshire and the Cornish dialects until you get west of Bodmin, or even Truro. The miners have a dialect of their own, which is manly and striking, and at the same time very Cornish.

Hicks used to be fond of telling of an old woman who said to him, "I mind you, Maister Hicks, when you was a babby. You was a very pretty babby!" looking up into his face; "and I sim you baint much changed neither." Considering his round, chubby face, and his time of life, this remark of the old woman was most absurd.

The last time I met Hicks was at the Saltash Railway Station. We were both going to a country house to stay a day or two, where he was as usual very amusing. We had hardly shaken hands, when he said to me, "I have just met a woman in Bodmin, with a child in her arms, who I knew lived twelve miles away, and must have walked that distance. I asked her what she was doing so far from home with her child. She said, 'He's a got the thrish, and I've a brought un in for a boy to blaw in the mouth of un, that never knawed his vather.'" A posthumous child was to cure the thrush by blowing in her boy's mouth, and she had carried her boy all that way for that purpose.

Hicks's stories were far-famed, were wont to set the table in a roar, and amuse a large party the whole evening. He had the great merit of being good company in any society in which he found himself, of whatever rank in life it might be; and he picked up many of his best stories by being on intimate terms

with men and women of the humbler classes. He was always alive to anything absurd, and any out-of-the-way expression, either grave or gay, falling from any one, it mattered not who, was sure to take a hold on his memory, and to be reproduced for the amusement of the world.

One of Hicks's early and best friends was George Wightwick, a man much sought after as a fine talker, a good story teller, and one of the best readers of Shakespeare's plays that ever read to the public.

In speaking of Hicks I must give a passing glance at his fellow wit. George Wightwick of Plymouth, a friend of Macready's, was the architect of the Lunatic Asylum at Bodmin, of which Hicks was the Governor, and one of the first to bring Hicks into notoriety. Wightwick was an enthusiast, and a great appreciator of merit in others. He was delighted with Hicks's fun, and put him forward as the most amusing person to be found in the West of England. Wightwick, as well as Hicks, was a well-known man throughout the West of Devon and Cornwall, and was much sought after as an entertainer of fellow guests at those most delightful parties at country houses, where many meet for a day or two in the mansion of a country gentleman. Perhaps there is nothing in the world so pleasant as a large party gathered together in an English country house—a fine old mansion situated in beautiful scenery—where every luxury is at command, and true hospitality well understood. Wightwick and Hicks in such a company, with their talk, their stories, and their music—they were both songsters—would be in themselves luxuries of the highest order. These two celebrities told stories of one another.

Hicks used to tell stories of one Captain Blank. I must use unreal names that I may not hurt the feelings of living persons, descendants or relations of the heroes of the stories, and I must pick out the commonest names in order to avoid identification, though the real Cornish names will be a great loss. Hicks told many absurd stories of this Captain Blank, a mining Captain. The title of "Captain" is a very favourite one in Cornwall, and is always bestowed on miners in authority. Wightwick, having heard many stories of Captain Blank, met him one day when in company with Hicks in Cornwall. Wightwick, with his usual enthusiasm, went up to Captain Blank and shook him warmly by

the hand, saying, "How are you, Captain Blank? I am delighted to see you." He was received with a cold, astonished stare, Captain Blank by no means partaking in the warmth of feeling exhibited by Wightwick. On which Wightwick said, "Captain Blank, my name is Wightwick." Captain Blank looked at him with great deliberation, and slowly answered, "I never heard of ee!"

When the British Association was at Plymouth in 1841, Hicks was at a large party at Mr. Thomas Woolcombe's, of Devonport, and there I heard some of his best stories, and his well-known song, descriptive of a Cornish wrestler who was pressed by a press-gang into H. M. Service when at a wrestling match at Cremyll passage. It is a widely-known Devonshire song, but Hicks's version was the best, and he sang it to perfection with his fiddle accompaniment.

SONG.

Come listen, father, and mother, and all,
 And zister Nan, I pray,
 And I'll tell 'ee a passel o' strange things
 Now I've a come home from saa ;
 I'll tell 'ee a passel o' strange things,
 About the wind and the tide,
 The compass caird, as you've a heerd,
 And lots o' queer things beside.
 Ri-too-ral-oo, ri-too-ral-oo, &c.

When I went up to Plymouth town,
 Along with a great man a ostling,
 I went over to Cremyl passage
 For to have a turn to wrastling.
 Leatheren breeches, they was the prize,
 Never the worse for wear.
 Dick Symons and me drawed two valls apiece,
 And the blind man¹ come in for a share.
 Ri-too-ral-oo, ri-too-ral-oo, &c.

Just as the double play begun,
 And the glock had knacked down zix,
 Up come a passel of ugly chaps
 With lots of zwords and sticks ;
 They aboosed Dick Symons, and darned his eyes,
 And called un all zorts o' names.
 "Darn 'ee !" says I. "Dick Symons," says I,
 "They've a perfectly spiled the games."
 Ri-too-ral-oo, ri-too-ral-oo, &c.

¹ A famous blind wrestler.

Then up come a feller with a great cocked-hat,
 He zeemed for to be the King.
 "Darn 'ee !" says I, "if you've any consait,
 Will 'ee plaze to stap into the ring."
 But they dragged us down to the waterzide,
 And drewed us into a boat.
 "Darn 'ee !" says I. "Dick Symons," says I,
 "They've a got the both o'rs afloat."
 Ri-too-ral-oo, ri-too-ral-oo, &c.

They pulled us out to a great big ship,
 Away var out in the Zound ;
 The wind was so high, and the saa was so rough,
 I thought us should all a been drowned.
 They halled us out to a great big ship,
 And into a hole in the zide.
 Lord a massy, I was zo zick,
 I thought I should a died !
 Ri-too-ral-oo, ri-too-ral-oo, &c.

A man, he stood at a great big wheel,
 And with un the ship he did guide ;
 Us shoved up some great clathes on to some great sticks,
 And us washed away out with the tide.
 One man he cried, "Luff !" another cried, "Tack !"
 And another zaid, "Helm 's a lee !"
 The devil might take all their luffs and tacks,
 'T was all the zame thing to me.
 Ri-too-ral-oo, ri-too-ral-oo, &c.

At last they spied a great French ship,
 And towards us he was a coming ;
 So they called up all the fellers to fight
 With a chap that went round drumming.
 Zo I stapped up to the maister's zide,
 I zim I zee the zword o'n.
 "Darn ee !" zes he, "if you'll foller me
 I warn us'll zoon be aboard o'n."
 Ri-too-ral-oo, ri-too-ral-oo, &c.

Us foller'd maister drew thick and thin,
 And for the smoke us could hardly zee un,
 Till at last I zeed a nasty French toad
 Just a going for to vlee² un ;
 Zo I stapped up to maister's help,
 I zim I never rin vaster.
 "Darn 'ee !" says I. "You French blackguard !" says I,
 "Was 'ee going for to skiver³ maister ?"
 Ri-too-ral-oo, ri-too-ral-oo, &c.

² Slay.³ Skewer.

“Wee, wee !” says he, with his parlee francee,
 And something about mon doo.
 “Darn ’ee !” says I. “You French blackguard,” says I,
 “I’ll very soon *do* for you !”
 And then he shut fore, and then he shut back,
 And round about maister kep prancing ;⁴
 I let an oak stick vall a top o’s head,
 And zoon zet his daylights a dancing.
 Ri-too-ral-oo, ri-too-ral-oo, &c.

I knacked un about—ah ! that I did—
 And I bate un black and blue,
 From the top o’s head to the zole o’s foot,
 Till I made un call out, “Mor bleu !”
 One officer had his head knacked off
 By manes of a cannon-ball.
 “Darn ’ee !” says I, “if it’s honour to die,
 I don’t like your honour at all.”
 Ri-too-ral-oo, ri-too-ral-oo, &c.

Then all the yards came tumbling down,
 And the great big masts likewise ;
 If Old Church tower’d a valled
 He couldn’t a made more noise.
 And when we had vairy beat mun all,
 And drove the French blackguards below,
 Maister he hauled the colours down,
 And we all o’ us gave a “Worroh !”⁵
 Ri-too-ral-oo, ri-too-ral-oo, &c.

So now come all you husbandmen
 And ostlers that would vight,
 Whenever you be called upon
 To wrastle for England’s right ;
 If you’d vight as I’ve a vaught,
 And I’ve vought cruel well.
 If any of they French blackguards come here
 Us’ll send them all to —.
 Ri-too-ral-oo, ri-too-ra-loo, &c.

Hicks’s violin was turned to good and laughable account. He used to give a ridiculous imitation of a musician who could only tune his fiddle by playing a particular familiar air on it, screwing the strings in the way common to fiddlers when he found some note in the air go wrong. He also imitated street players with their songs. There was a famous song of his, in which he mimicked a blind street fiddler and singer and his wife, with a

⁴ The action of fencing.⁵ Hurrah.

dog called Lion leading the blind man. It was a song celebrating the triumph of the Duke of Wellington at Waterloo, each verse being sung in the cracked voice of the blind fiddler, with fiddle accompaniment, repeated by the wife in a shriller cracked key. After every verse the blind man gave the dog a kick, saying, "Get along, Lion!" with an advance of a pace or two in the street. Here are one or two verses of this song :

Come, all ye vadliant heros bold,
To you I will declare-are,
The wonders of great Wedlington,
What made the world to stare-are.

(Wife repeats.)

Get along, Lion.

The Zixteenth, Zeventeenth, and Eighteenth
They foft⁶ most desperate-ly,
And drove the French to Paris gates,
Where they for quarters cry-y.

Get along, Lion.

Nit to forget brave Blucher who
With his airmy played his pairt,
In conquering that proud ty-ry-rant,
Usurper Bonypairt.

Get along, Lion.

And now the battle is over-er
Us will rejoice and sing,
And drink a bottle of Bur-gun-dy
To the royal George our king.

Get along, Lion.

Hicks was Governor of the Bodmin Lunatic Asylum, as I have said, for twenty years. I have been told, that when he first went there he found the old system prevailing, and that he introduced the modern methods of kindness, in lieu of cruelty and severity. One of the great characters in the asylum (many great characters were there in Hicks's time, as you may suppose), whom I will call Daniel, on the principle that no real names shall be used, he found on a bed of straw, chained, in a dark cell, and treated as a dangerous lunatic. He discovered that this person was a very clever man, though possessed with some mischievous delusions, a great wit, and a philosopher in his way. Hicks released him ; found him safe ; employed him in the asylum

to take care of the pigs, and do other useful work ; and made so much of him and his sayings that he became a well-known personage in the county. Anyone attempting to chaff Daniel, including Hicks himself, was pretty sure to get the worst of it, especially as he was by no means particular as to what he said. It was a risk to say anything to him in hopes of getting an amusing reply. A gentleman, on a visit to the asylum, once said to Daniel, "I hear, Daniel, you are Hicks's fool." "Ah," said he, "I zee you do your awn business in that line." One or two of Hicks's stories, and of Daniel's sayings, found their way into *Punch*. Daniel now and then was allowed to go out of the asylum, and Hicks occasionally had to find him to fetch him back. He once found him at an auction, sitting at a table with farmers and others, drinking gin and water gratis. He rose up when Hicks appeared, not wishing to be recognized as a lunatic there, and said, "I tell 'ee what I've obsarved, Mr. Hicks. They that scat" (Cornish for broke, as a bankrupt) "last be giving most money." Rather a blow to the buyers present. He was once asked, "Where does this path go, my man?" He answered, "I don't know. I've a zeed un bide here the last forty year." This was told in *Punch* in Hicks's time in a different way. Daniel was sitting on the high asylum wall when the company, horses, and trappings of a circus passed by. He said to the leader, "They there sparky" (speckled) "horses don't pay no turnpikes here." The man stopped and asked what he meant, when he repeated what he had said. There was a turnpike at the bottom of the hill, which Daniel could see from the wall, and he greatly enjoyed the dispute and row that ensued on the man refusing to pay the toll. After a while the man came galloping back to know the truth about those horses paying no turnpikes. "Because you must pay it for 'em, to be sure," said Daniel. It may then have dawned upon the circus man that he was speaking to a madman on the wall of an asylum. Daniel used to affect to despise Hicks, no doubt because Hicks had to keep him under certain control. He said to me one day, "What's the use of he here?" pointing to Hicks. "He's got nothing to do, and he's great expense to the county. I could do all he does."

Another hero of Hicks's was a poor fellow who had gone mad on etymology ; I will call him Burke. There are many persons

mad on etymology, but not quite bad enough to be dangerous to life or limb and put into an asylum, though they play mad pranks with language. Etymology is a study of considerable risk to those who are not trained philologists, and many there are who follow it and tumble into the pitfalls that abound in its intricate ways. Poor Burke should be a warning to all such rash speculators, who should remember that the mind is delicately poised, and may be overthrown by a blow from any quarter. Playing with etymology is playing with edged tools, as Burke found. Burke was much given to writing, and Hicks, with the kindness habitual to him, supplied the scribe or scribbler with pen, ink, and paper to keep him quiet. I knew the asylum and some of the patients in Hicks's day, and Burke used to send me sheets of foolscap covered with his manuscript. I give one specimen, as an example of the mind of a man gone mad on etymology—an example and a caution. This extract is one of the most coherent of many closely-written pages, a real mad-man's manuscript:

“THE BLESSING AND THE CURSE.

“Now O ye Dignitaries, ye ycleped Divines of the Church, give us the root of these two words and I will engage that you shall convert or Renew every soul in your congregation the next sermon you preach.

“‘The Blessing.’ As we judge of men so we should judge of words—that is by their Havage, Descent or Family and by the company they keep. A sure criterion. Well then, there is something about this word that to the Phisiognomist, or Lavature, is very unfavorable from its having the self-same head as Blast and Blood, Bleed and Bled and Blasphemy, Black and Blackguard. It is rather ominous that Bless is formed of B and less, now less is minus, under, Infra, Below or sub, it all makes against the word being desirable, especially as *Lesson* is the same as *Lecture*, *Discourse*, *Sermon*, *Homily*, *Dialogue*, *Decalogue* (*Diabolus*) the infernal Law or Yoke.”

Then he gets very mad as he writes, which he always does, and proceeds with a curious chain of ideas.

“However, Blessing and Curse is Gerizen and Ebal; or Beatitude and Mahner; or Good and Evil; or God and Mammon; or Gog and Magog; or Man and Woman; or Peace and Plenty;

or Cornucopia. Blessing and Curse is Alpha and Omega; or Castor and Pollux," &c.

He usually begins by attacking some well-known authority, but as he writes he gets excited, and becomes more and more incoherent. The association of his ideas is curiously mixed, the sounds of the words, and their meaning or their place in literature, in Latin or English, or in mythology, being all confused together. He proved in one of his papers that light and darkness were the same things (a sort of paradox he was very fond of), because to pitch was to alight, and pitch was darkness—pitch-dark. Burke was a mathematician by profession; that is to say, he taught mathematics in a country school. He had not gone mad on a subject of which he knew something, but he had, naturally enough perhaps, gone mad on a subject of which he knew nothing.

Hicks used to say that the men in the asylum were more interesting than the women, because men went mad on all sorts of subjects, whereas women went mad nearly always either on love or religion.

When Hicks first took charge of the asylum he gave a supper to those of the inmates whom he considered safe. He took the head of the table, and asked one of them, who was a preacher, to say grace. The man began, but could not finish, and went on saying grace until the rest of the company became very wild with impatience, and a sailor called out, "Avast there!" The man having at last sat down, Hicks saw one of the patients with his eyes in a fine frenzy rolling. He therefore asked him what he would take, by way of quieting him. The man replied, "A slice of Bunker's Hill." To which Hicks answered, "Help yourself." The beef and plum pudding made all quiet in the end.

One of the methods for quieting a refractory patient, I believe still in vogue, is a douche bath applied to the head; and as Hicks thought it a very severe remedy, he tried it on himself, that he might know what it really was. He told me it was very severe.

Hicks had a very large collection of stories picked up anywhere; amongst others, some from the Court of Assize held at Bodmin, where he used to entertain the Bar mess.

The following was one of his best. It was a horse case. Horse cases are difficult to deal with, and in the course of the trial a horsey-looking witness was put in the box.

Counsel asked him what happened?

Witness. I ses, ses I, how about the hoss? and he zaid he'd give me ten shilling to zay nothing about un.

Counsel. He did not say *he* would give you ten shillings.

Witness. Yes a did, that's exactly what a did zay.

Counsel. He could not have said "he," he must have spoken in the first person.

Witness. No; I was the first person that spoke. I ses, ses I, how about the hoss?

Counsel. But he did not speak in the third person.

Witness. There was no third person present, only he and me.

The Judge interposing. Listen to me, witness. He could not have said, "He would give you ten shillings to say nothing about it, but '*I*' will give you ten shillings."

Witness.—He zaid nothing about your Lordship. If a zaid anything about your Lordship I never heered un. And if there was a third person present I never zeed un.

Point given up.

He heard a witness asked, if the prisoner had been drinking? The witness replied, that "he was a little as regards of liquor."

"What do you mean by that?"

"Torsticated."

Another witness he heard asked, "How many glasses are there in a bottle of champagne?"

"Aight for general; but when maister zays I must make un go zo var as I can, I gets thirteen out of un."

Maister was present in court.

Hicks heard many speeches at public meetings, and could speak well himself, generally in a humourous vein, as may be supposed. He remembered and re-produced speeches that were remarkable for being out of the common run. On the unveiling of a bust of a Cornish worthy at Truro, he heard a class-leader of the Methodist body, who had first suggested marble as better than clay for such a purpose, say as follows:

"When I zeed your Honour a muddled in a nub of pipe clay, and your busk in plaster pallas in the image-maker's shop, I zays

to Mr. Burnard, and says I to the *I*-talian, this is rather crips material. Why don't you take a slab of alabaster and cut his Honour out? And there you be, fixed upon the pinacles (he meant pedestal) in the Council Hall above, for ever and ever, and ever and ever, till you and me mit together in the land of marrer and fatness."

Another speech he used to give was made by a farmer, who had had notice to quit, at a rent dinner, with the landlord in the chair. The farmer said :

"I rise to propose the health of the honourable chairman. The honourable chairman hath a zaid what he 'th a din for the varmer ; but a hathen'd a zaid what the varmer 'th a din for he. The true varmer's vrien'd was maister Coke, the late Earl of Leicester that was, and if the honourable chairman wid do what maister Coke did do, he wid do a good deal better than a do do."

He heard a man say in a speech, "An Englishman's house is his castle ; the storms may assail it, and the winds whistle round it, but the king cannot do so." A ludicrous perversion of a well-known quotation.

Another said : "Those was troublous times ; and when a man laid hisself down at night, he did not know that he should get up in the same position in the morning."

He heard a well-known magistrate say to a jury, who had applied to adjourn for luncheon, "All I can say to you, gentlemen, is, that the longer you sit there, the sooner you will get away." It was of course a slip of the tongue, but no absurdity escaped Hicks.

Among Hicks's own speeches may be mentioned one he delivered in returning thanks for the ladies at a flower show. He referred to a number of flowers by their long Latin botanical names, and then said he thought the good old English names better adapted to ladies, such as "Forget-me-not," "Boy's Love," "Meadow Sweet," "Bachelor's Buttons," "Look-up-and-kiss-me," "Love-lies-bleeding," and "Sweet William," taking care that the last should be applicable to himself. He told the Looe people, in a speech on the occasion of opening the new bridge, that they might now play the game of unlimited loo.

He was a man of taste, and had many friends amongst artists, as well as musicians, who valued his criticisms on their art. One

of his friends, eminent for his drawings, and a good singer, was painting a sea subject at East Looe, on the rocks at low-tide. Hicks went to see him from Bodmin, and arrived at West Looe to be taken across the harbour in a boat. He was rather surprised to find a boatman waiting for him, who said, "I've a been looking out for ee the last day or two; I knowed you'd come. He's over here now. He's been hollering and screeching. He zits at low-water down among the weed, a painting of something, and he calls out, 'Come into the garden, Maud;' a pretty garden he's a got there! 'I'm here at the gate alone;' why there's no gate within miles of un. You can take un."

Hicks, as Clerk of the Board of Guardians, was taking down the minutes at a meeting of the Board, when a member of the Board was looking over his shoulder. This guardian said to him, "I beg to call your attention to a error, Mr. Hicks." "What is that?" said Hicks. "You've a left out the *h* in overplush." On another occasion the name Socrates had to be written, a quotation perhaps. A man looking over his shoulder said, "Zokrates! Who's he? I never heerd of un." Hicks looked up rather surprised, when the man corrected himself by saying, "Except in the Scripture."

Hicks met a man in Bodmin one day, and said to him, "You are not looking well. What is the matter?" The man, who was a well-known character, said, "I've a had an indifferent night, Mr. Hicks." "How is that?" said Hicks. "I sleep with father," he said. "And I reached forth my hand, all in the dead waste and the middle of the night, and couldn't feel nothing; so I ses, ses I, Wherever is my poor dear old aged tender parent? I got up and struck a light, all in the dead waste and middle of the night, and sarched the room and under the bed; and ses I, Wherever is my poor dear old aged tender parent? I went down over the stairs, all in the dead waste and the middle of the night, and sarched the coal-hole; and ses I, Wherever is my poor dear old aged tender parent? I went out into the garden, all in the dead waste and middle of the night; and ses I, Wherever is my poor dear old aged tender parent? I went down to the parsley-bed, all in the dead waste and middle of the night, and there I seed un; he'd a cut his throat with the reap-hook. I took un by the hair of his head, and I ses, 'You d——d old blackguard, you've a

brought disgrace on the family.' I sent for the doctor, and he sewed up the throat of un before the vital spark was extinct. So you see, Mr. Hicks, I've a had a rather indifferent night."

Hicks told a story of a man who was very much exercised in his mind by the proceedings of one Stoke, who it appears was a magistrate.

"Curious man, Stoke. He unhanged all the gates 'twixt Liskeard and Callington one night. Curious thing for a justice of the pace and a magistrate of the county for to do. Folks says he's a fule, but Stoke's no fule; he's a very clever man. Stoke hates the Quakers; and he dressed up his sarvent-man like a Quaker, made un drunk at the public-house, and wheeled un like that through the streets of Liskeard in a wheelbarrow. Curious thing for a justice of the pace and a magistrate of the county for to do. Folks says he's a fule, but Stoke's no fule; he's a very clever man. He sot a pair of coach wheels a running down the street (a very steep street), and nobody could stop um, till they ran into a cloam shop and seat all the crockery. Curious thing for a justice of the pace and magistrate of the county for to do. Folks says he's a fule, but Stoke's no fule; he's a very clever man."

Hicks was driving along a dark road one evening, when he came upon an empty spring-cart, and two men close to the hedge on the roadside. One man was drunk and the other was sober, and the drunken man was reproaching himself for his bad conduct. Hicks knew them—he knew everybody—and stopped to hear what was the matter. The drunken man was saying, "Ah, too bad, too bad, too bad! What shall I do? what shall I do? If I was called to my last account, what should I zay? what should I zay?" The sober man replied, "Zay! What could ee zay? Zay you've a been to Liskeard a auditing of accounts, and took a extra glass. 'T will be overlooked for once. 'T is no good telling lies up there." So it went on, the drunken man in lamentation, crying, "Too bad, too bad!" and the sober man trying to administer comfort. Hicks met the sober man a day or two afterwards, and asked how his friend got on that night. The answer was, "He's a very affectionate man to his family, and when he got home he took the babby out of the cradle for

to kiss un and velled vore with un upon a vuzzy vaggot. Jane, her got into a passion and laid to un with the broomstick, while he kep voaching upon the babby. When I comed away her'd a thrashed un sober; and they'd a got the chield, naked and screeching, on the dresser a picking out the prickles."

Hicks knew a man who was a morose, dull, heavy, religious fanatic; and this worthy had married a widow with a lively, laughing, singing daughter, who was always singing songs and making a noise in the house. The man reproved the girl for her gaiety in this vineyard of mortality, and said to her, "Suppose you was took suddent, and called to your last account with the 'Soldier's Tear' in your mouth!"

Hicks used to meet Thackeray at the Garrick Club. One evening, a member of the club said, in Thackeray's presence, he should like his friend ill (leaving out the H) to be a member of the club, when Thackeray said, "It makes us rather bear those ills we have, than fly to others that we know not of."

Hicks was present once at an interview between a rural Dean and a sexton at a country church. There were sheep in the churchyard, and the Rural Dean said he did not like to see them there. The sexton replied, "They won't bide there long, us be going to till un to taties next week." The Rural Dean also found fault because there was no table of affinity to be seen in the church. The sexton said, "A table of affinity is no good to us, there's nobody in our parish a going to marry his grammer, nor no such nonsense."

Hicks's great jury story was the story of all others which alone might have made a reputation. It is impossible to give it in writing as it was told; but as Hicks can no longer tell it, this example of trial by jury should be placed on record. The story has a deep moral in it; for it is a most graphic account of how juries used to do rough justice, when the laws and the judges were very severe, and hanging was a commonplace event. The jury might well say that they hung; for a verdict of guilty was a sure hanging matter, any particular circumstances notwithstanding. Mr. Baring Gould, in his preface to John Herring, tells a very good story of jury justice in Devonshire, and Hicks's story is a Cornish one of a more elaborate nature. Whether jury

justice in this case was real justice, as it was in Mr. Baring Gould's story, is another matter which has nothing to do with Hicks. Before venturing upon the story, I must tell what happened to Hicks in consequence of his amusing his numerous friends with it. He was on a jury himself, and when he and his fellow-jurymen took their seats round a table to consider their verdict, he observed that a profound silence reigned, and no one, not even the foreman, took any steps to begin business. Hicks waited with some curiosity to see what would happen, looking out as usual for something to turn into ridicule. At last the foreman looked very hard at him, and said, "Now none o' your nonsense, Mr. Hicks."

A doctor of the name of Donnell was tried, at the assizes at Launceston, for the murder, by poison, of an old aunt of his at Flushing, and Dr. Cookworthy, a very well-known man in the county, gave evidence as to the fact of arsenic being found in the stomach, which puzzled the jury immensely. Dr. Cookworthy, being a man of considerable force of character, and afraid of no one, got into a wrangle with the judge and counsel, lost his temper, and unintentionally muddled the case.

Hicks used to tell the story something in this way. He called the heroes by their right names, but I substitute common names for the reasons I have given.

Hicks met Mr. Lush, whom he knew very well, at Liskeard, and said to him, "What are you doing here?" Lush said he was attending Liskeard market, and that he attended Callington market and Liskeard market alternate weeks. "Oh," said Hicks, "I should have thought Launceston market was the nearest for you!" Lush replied, "Ah, I arn't a been to Launceston market not since thicky Donnell was tried! I was voreman to the jury at that there trial." "Were you?" said Hicks. "Why did not you bring him in guilty?" "There you go, Mr. Hicks," said Lush; "that's why I don't go to Launceston market. Everybody says, 'Why didn't you bring un in guilty?' Sech hignorance! What can they know about the caze, and what us had zaid to us? Us was shut up with no vire nor candle, nor nothing to ate nor drink for hours. Us came to decision in the dark." "How was it then?" said Hicks. Lush explained by telling the facts. "Us was shut up without vire nor candle, and nothing to ate nor drink, and 'twas that dark I couldn't zee the jury, but I know'd zome

of um by their voice. Zo I thought I'd get the verdict of 'em, one after the other; and, hearing Jones's voice, I says to un, 'Mr. Jones,' says I, 'what do you think of these here caze?' He says, 'I be for shutting of it op. If a has killed the old woman, I know by two he'th a zaved from drowning, and if you draw one agin the other I bain't for hanging of un.' 'That's one,' says I. Then I says to the next, I couldn't zee un, but I heard the voice of un, 'What is your opinion of these caze?' He zaid, 'These here doctors are too frolicsome with their laudadums and their doldrums. If a have mit wi' a misfortune with the old woman, I'm agin hanging of un.' Zo I says to the next, 'Winnick,' says I—for I know'd un by his voice; but thinking the voreman to the jury didn't ought to call a man by his nick-name ['winnick' is the nick-name for a cheat]—'Winnick,' says I; 'Mr. Brown,' says I, calling of un by his right name afterwards, 'what do you think of these here caze?' He says, 'I be for giving of un three months in the sheriff's ward.' 'Oh,' says I, 'tis neck or nothing!' 'Then,' says he, 'I'm for nothing.' The next man to he, when I asked un, zaid, 'I be for giving of it agin the rabbits and onions. Maister Cookworthy hath a zaid 'twas the rabbits and onions. No old woman oft to ate rabbits and onions afore her goes to bed. If it didn't kill her, it oughter!'"

The old woman had eaten rabbit and onions for supper, and Dr. Cookworthy had given medical evidence as to the contents of the stomach. The stomach had been sent to him after it had been examined by the local doctors, at which he was much annoyed. He said, in giving evidence, that the smell of arsenic was like the smell of onions; and he got into a row with counsel and the judge, which had a notable effect on the jury, as he was such a very well-known man. In reply to a direct question by counsel, "Did you find arsenic in the stomach?" Dr. Cookworthy replied, "If the stomach had been sent to me at first, before it had been examined by others, I could give an answer; but as it is, I can only say it probably contained arsenic." Then followed the usual brow-beating by counsel, but in this instance they had got hold of the wrong man. Counsel said, "I want an answer to my question, Yes or No." The reply to that was, with some warmth: "If the stomach had been sent to me at first, before it had been examined by others, I could give an answer; but as it is, I can only say it probably contained arsenic." Counsel (with warmth): "Did you

find arsenic in the stomach? Yes or No, sir." Dr. Cookworthy (still warmer): "If the stomach had been sent to me at first, before it had been examined by others, I could give an answer; but as it is, I can only say it probably contained arsenic." The judge then interfered, and said with severity, "Answer Yes or No to the question, witness." Dr. Cookworthy, in a towering passion, not to be bullied by any judge or counsel, repeated his answer: "If the stomach had been sent to me at first, before it had been examined by others, I could give an answer; but as it is, I can only say it probably contained arsenic." As it was quite hopeless to get any other answer out of Dr. Cookworthy, judge and counsel gave it up; but the quarrel had a great effect on the jury, and put them in a state of confusion as to the merits of onions and arsenic. This was the Dr. Cookworthy episode in the story.

To return to the proceedings of the jury. Lush continued, "I then asked the next man, and he zaid, 'If us hang un, it wan't bring the old woman to life again.' 'Very true,' zaid I, 'that never struck me before.' And I put un down as agin hanging. After he I asked Robinson; I always shall respect that man. He spoke out like a man. He says, says he, 'Just as you plase, Mr. Lush; hang un or no, 't isn't a happenny odds.' That was zix, and one more of the same opinion made zeven, and the majolity carr'd it agin the minolity, and us gave the prisoner the benefits of the doubts. So you zee, Mr. Hicks, it's aisy to zay, 'Why didn't you bring un in guilty?' but 't is such hignorance."

This was Hicks's far-famed jury story, which he told to perfection, putting vividly before his audience the good old system of compelling a jury to bring in some verdict or other by shutting them up in a dark room without fire or candle, or anything to eat and drink—"when prisoners were hung that jurymen might dine."

In commemoration of Hicks, of Bodmin, the great humourist, who unfortunately left no writing or notes behind him, trusting always to his wonderfully accurate memory, it is well to place on record some of his sayings and doings.

EARLY WESTERN RAILROADS.

BY R. HANSFORD WORTH.

(Read 8th March, 1888.)

My excuse for bringing this subject forward is to be found in the rapidity with which events are forgotten. Facts, unless put on record, are soon lost in oblivion which is almost prehistoric in its utter blankness. I have had personal experience of this when on the track of various branches of my subject, having frequently found myself just a year or so too late to recover information which is now irretrievably lost; while in a year or so more, much that I have succeeded in obtaining would have vanished also. This is the more surprising, as my subject is essentially modern; since the first locomotive which ever carried passengers ran its trial trip up the Beacon Hill at Camborne no longer ago than Christmas-eve of the year 1801, and its inventor, Richard Trevithick, died just fifty-five years ago; while the first tramway which I have to mention was not commenced until 1803, being thus in point of date two years later than Trevithick's locomotive.

I propose to confine myself, in the main, to the rail- or tram-road or way, and shall only refer to the locomotive in connection with those lines on which it has been used. The history of the invention of the high-pressure steam engine, and the first construction of the non-condensing locomotive engine, I shall regard as outside my subject, although the temptation to refer at length to our great West-country engineer is well-nigh irresistible.

It may perhaps be useful, before referring to our own locality, to give a very short sketch of the first growth of tramways in other parts of England. In or about the year 1676, rails of timber were laid in certain parts of the colliery districts, and carts with four wide rollers, in place of the ordinary wheels, were employed to run on them. Later on these rails, instead

of consisting of single pieces of oak, were built in two—one piece taking the strain or weight, and the other piece the surface wear and tear. This second piece was of course replaceable. After this bars of wrought-iron, in size about two inches wide by half-an-inch deep, were placed at the worst gradients to render the necessity for constant repairs less. These bars were fixed by means of countersunk spikes.

Later yet, in 1767, the Coalbrookdale Co. used cast-iron rails in five feet lengths, four inches wide, one and a-quarter inch thick, and each rail fastened down to the sleepers by three spikes or bolts. This rail being made L-shaped, acted as a guide as well as a bearing surface for the wheels; and from this fact the modern tramway seems to have derived its name, as such rails acted as a *trammel* for the wheels. In 1789 edge rails, such as were used at first on the Plymouth and Dartmoor Railway, were introduced.

In Devon and Cornwall, as elsewhere throughout the country, most of the earlier rail- and tramways were subsidiary to canals. The first form of tramway of which we have record in the North was employed for the carriage of coal from the pit mouth to the canal, and in the West the earlier ways were auxiliaries either to canals or harbours.

THE TAVISTOCK CANAL AND INCLINE.

In 1803, works were commenced for the canal between Tavistock and the River Tamar at Morwellham, which were completed in 1817. The canal itself is four and a-half miles long, and two miles of this length are tunnel, which at its deepest point is 460 feet below the surface. The canal does not communicate with the river Tamar directly, but by means of an inclined plane.

I went to Morwellham last Christmas to see what was left of the original plane, and I describe the remains as I then found them. If the pattern rail now left on the ground had been the same as originally used, it would have been the earliest rolled iron rail of uniform section of which we have evidence in the West. Mr. Moses Bawden has, however, kindly informed me that the present rails are not of the same pattern as those first used, although these too seem to have been of uniform section, and resembled a modern street tram-rail, or a Great

Western bridge rail inverted; they were relinquished because the flange of the wheel cut them out so soon. The canal terminates at a point 240 feet above the river level, and the inclined plane connects the two. On this incline were laid two lines of rails, and there are two winding barrels on the engine at the top. The second line of rails has been removed, but I am informed that it was used by the descending trucks.

I was very much struck with the picturesque appearance of the water-wheel and winding machinery, by which the incline was worked. The wheel itself, which was worked by the waste water of the canal, is about three feet breast, and twenty-five to thirty feet in diameter. On its axle is fitted a somewhat ponderous bevelled cog-wheel, into which gears another of similar dimensions. This is fixed on a stout wooden axle, which rises almost vertically, and moves, by the aid of another pair of bevel-wheels, another horizontal wooden axle about one foot eight inches square in cross section. On this last is fixed a large drum, on to which winds the chain, of four-inch link and three-quarter-inch iron, which was used to draw up the ascending train of trucks laden with coal, lime, &c. Another large drum, with a wire rope wound on it, is so connected with this last by a pair of ordinary toothed wheels that the descending train, laden with copper ore, was made to assist the water-wheel in drawing up the ascending trucks.

The incline at places is as steep as one in six; and I found the remains of a truck, in which one pair of wheels was four inches greater in diameter than the other, the idea being to keep the body of the truck level. On the quay at Morwellham, and also at the head of the incline, are still to be seen remains of the permanent way.

The gauge of the line was four feet three inches. It consisted of rolled iron flat-headed rails, fixed into cast-iron chairs by means of wrought-iron keys or wedges about six inches long and half an inch thick. These chairs were each secured by wrought-iron spikes to stones, either of granite or slate (killas), about two feet long by one foot wide, and six inches deep, placed about three feet apart, centre to centre. I calculate that the rail, which was only three inches deep and one inch and a-half wide at the top, would weigh about 25 lbs. per yard run.

While looking round the canal terminus I noticed an ancient

canal boat (length thirty feet, and five feet beam) made of small pieces of sheet or boiler plate-iron riveted together, the whole being evidently on the eve of dissolution. Apparently in order to hold it together it was partially slung from a cast-iron crane originally used for unloading the canal boats.

PORTREATH RAILWAY.

In 1809 the first tramway in Cornwall was opened. It ran between Portreath and the mines at Poldice; and Lord de Dunstanville laid the first rail, October 25th of that year. The line was about four miles long. Hitchin and Drew's *History of Cornwall* (1824) notes concerning it: "A rail or tramroad has been made, over which the wheels of the carriages that are constructed for the purpose run on cast-iron, which facilitates in an extraordinary manner the progress of the vehicles, and greatly lessens the force of animal exertion." Mr. Francis Michell, c.e., of Redruth, informs me that the line has been taken up, and that it consisted of two angle irons, placed face to face, and not back to back, as was usual; thus, **L J**. These irons were fastened to stone blocks, and the gauge was about three feet.

THE HEYTOR RAILWAY.

The next railway to which I have to refer was three years later in date than the Morwellham incline, but of a more primitive character, resembling, in fact, an Egyptian quarry-road almost as much as a modern tram-line.

In 1792 Mr. James Templar obtained an Act for the construction of a canal from Bovey Tracey to Newton to communicate with the river Teign, and made it at his own expense, completing it in 1794 to Stover. This canal, known as the Stover Canal, is six and a-half miles long.

The same Mr. Templar also completed, and likewise at his own expense, a tramroad from Heytor to Stover to communicate with the canal. This tramway, opened in 1820, was made with the intention of developing the Heytor granite quarries; and at the same time workmen's dwellings were erected in a sheltered position on the flank of the tor. These dwellings are now known as "The Buildings."

The way itself consists of two parallel lines of granite blocks, each line having a rebate worked along its outer half. The gauge, or distance between the rebates, is exactly four feet. The depth of the rebate varies in places from three to six inches, and the action is precisely similar to that of the Coalbrookdale cast-iron rails, and very like that of the cheek or guard rail now fitted to lines on sharp curves or at crossings. The horizontal portion of the rebate carried the weight, while the vertical portion bore against the inner circumference of the wheel, and kept it in its place.

At one place at Bovey rails of iron almost precisely similar to the Coalbrookdale pattern have been used, where the line crosses a stream by means of a wooden bridge. At curves the stones do not seem to have been dressed to form, but short, straight stones were worked in, which by the constant friction of the wheels soon wore down to a sufficiently accurate shape. The stones vary much in all dimensions, but perhaps an average block would be four feet long and one foot six inches square; many of them are as long as seven feet. Points and crossings were formed in large blocks by working grooves six inches wide and two or three inches deep. At no place was any serious cutting or embankment attempted, for the greater part both being only such as were necessary to carry the road along the inclined face of a hill. No attempt was anywhere made to bond together or connect the stones.

The reason for the substitution of granite for iron in this tramway is of course evident. Where granite was to be had for the cost of production, it is not surprising that as a material it should have been adopted. And it does not follow that because the material was cheaper it was necessarily inferior. The cast-iron rails at that time in vogue were a constant source of annoyance and expense, invariably giving way at the wrong moment, and being very uncertain in their general behaviour when heavily laden. Now the Heytor granite is an exceptionally good material, and the granite-way as laid was far superior in many respects to the cast-iron rail. This tramway was thoroughly efficient, and quite up to its work; for the two large blocks of granite having the city arms upon them, at either end of London Bridge, came from the Heytor quarries over this line to Stover, and were thence shipped to London. The Waithman monument, in Ludgate

Circus, was also quarried at Heytor, and brought down over this tram-line.

I have already alluded to the Heytor granite as an exceptionally good stone. It is a fine-grained porphyritic rock which can be obtained in blocks of almost any desired size; but owing to the lie of the jointing it involves a large expenditure of labour to quarry out, and from this reason has now ceased to be extensively worked. The quarry has not, however, been altogether deserted, as a few men were employed there when last I visited it, on which occasion Mr. Barry, C.E., of Newton (to whom I must express my indebtedness), very kindly walked over the railway with me. Besides the principal quarry at Heytor, branch lines were also run to neighbouring quarries, but the whole tramway has now fallen into disuse. As to the trucks, they were merely modified road waggons. The wheels, as in all the earlier rolling stock, ran free on the axles, and I am informed by Mr. Barry that the leading truck of a train usually had shafts.

BUDE CANAL.

In 1819 an Act was obtained for the construction of the Bude Canal. This canal had at various points a series of inclined planes which were worked by steam power.

PLYMOUTH AND DARTMOOR RAILWAY.

We now come to our own more immediate neighbourhood—to the Plymouth and Dartmoor Railway, the first idea of which originated with Sir Thomas Tyrwhitt. This gentleman's statement, made at Plymouth to the Chamber of Commerce, is of considerable interest. Briefly stated, the following prospects were held forth:

The barren slopes of Dartmoor were to be reclaimed, to which end lime and sea-sand were to be imported as manures. Pauperism was to be decreased, and a flourishing colony of agriculturists was to be planted on the moor. By this means Plymouth would acquire a valuable back-country, which would materially increase her prosperity as a port. It was in fact to be an undertaking profitable alike both to the nation and to the shareholders, the latter apparently expecting an eighteen per cent. return on their capital. As the subject is of such local interest, I think it may be well to give an abstract of Sir Thomas Tyrwhitt's statement,

which is also a good example of the early railway prospectus. Sir Thomas said :

“To reclaim, and clothe with grain and grasses a spacious tract of land now lying barren, desolate, and neglected ; to fill this unoccupied region with an industrious and hardy population ; to create a profitable interchange of useful commodities between an improvable and extensive line of back-country, and a commercial seaport of the first capabilities, both natural and artificial ; to provide employment for the poor of several parishes ; and to alleviate the pressure of parochial burdens by a method, at once simply ingenious, and comparatively inexpensive, form altogether such a stimulus to adventure, and such a scope for exertion, especially to a wealthy company, as must dilate the benevolent heart of the patriot, whilst it emboldens the capitalist gladly to lend his assistance in carrying the plan into execution.”

The last sentence evidently implies a doubt that the “benevolent heart of the patriot” counted for much unless the security was good. Continuing his statement, Sir Thomas Tyrwhitt divides his subject into five heads ; viz., I. Plan ; II. Expense ; III. Funds ; IV. Income ; V. Benefits.

I. “*Plan*.—The road will commence at Dartmoor Prison, which lies about twelve hundred and fifty feet above the sea, and thence traverse the Moor and Roborough Down in a south-westerly direction, to the Laira at Crabtree, by a gradual fall of half an inch in three feet. The distance between the two places will not, in all probability, exceed twenty miles, according to the line marked out in the plan ; and the road ought to be an ascending and descending one, or what is technically called a ‘double road.’”

In a footnote to this last clause, it is explained that a double road occupies eighteen feet of land in width.

II. “*Expense*.—It is calculated that the present road may cost £2000 per mile.

III. “*Funds*.—To meet the charges, both direct and contingent, it will be necessary perhaps to raise £45,000 by subscription, in shares of £25 each.”

A somewhat encouraging footnote is here appended, with a view probably to future financing operations. “Experience has proved in Scotland that not less than eighteen per cent. may be derived from railroads.”

IV. “*Income*.—The principal part of this, at first, will arise from the tonnage of importable and exportable commodities.

“IMPORTABLE COMMODITIES.

“*Lime*.—In cultivating the moor and other unimproved parts on both sides of the road, this must be esteemed an indispensable article, not merely in the onset, but during the long course of successive years.

“*Sea Sand*.—Many assigning much importance to this article prefer it to lime as a manure.

"*Timber*.—In proportion as buildings accumulate around the road, as population increases, and as the wants of culture diffuse themselves, will be the want of this valuable article, to which in fact hardly any limit can be placed in a region so denuded of wood as Dartmoor.

"*Coal*.—Next to timber justly ranks this essential of domestic life.

"*Culm*.

"*Groceries*.—*Tea* and *sugar* are become absolute necessities in the present day, and these, added to *wine*, *spirits*, *beer*, *porter*, and other *household requisites*, would be sure to give birth to a productive tonnage.

"*Furniture*.—The *colonisation* of Dartmoor will carry in its train a necessity not only for the importable commodities before spoken of, but for many others, which, though of comparatively inferior consequence, will be more or less wanted by the colonists. Amongst them is furniture.

"The use of this term [*colonisation*] the author hopes will not be objected to; it being equally applicable, in his opinion, to the improvements contemplated on Dartmoor as to like designs in Canada.

"*Planting*.—In the progress of colonisation the formation of plantations will become essentially requisite, as much for the sake of rural embellishment as to protect the newly-enclosed grounds and buildings.

"EXPORTABLE COMMODITIES.

"*Granite*.—Beside the weightier stone for government or private uses, the Company would be enabled to supply, with the same ease and profusion, curbs and paving stones, gate-posts, highway stones, and gravel, at a rate which, it is presumed, would undersell those procurable in any other quarter.

"*Peat*.—It is impossible to view the face of Dartmoor without feeling sensible of the numerous uses to which the superabundance of peat in this district may be applied. Amongst others, the heat given by a combination of peat with coal is allowed to be exceedingly powerful; and the author has reason to believe that iron, fused with this admixture, is less liable to crack than when coal alone is employed in the process.

"*Mining Products*.—Mr. Mawes, the celebrated mineralogist, who has investigated the forest of Dartmoor with much attention, is of the opinion that the latter contains the mineralogical productions of almost every clime, with but few exceptions. If iron, copper, and tin could be raised and smelted on the spot, without the necessity of resorting elsewhere, the saving of expense, both to Government and the public, might be decidedly pronounced incalculable.

"*Flax*.—This next article, unlike the preceding ones, is not indigenous; but experiments have proved that it may be naturalized on the soil of Dartmoor, and perhaps to an extent which will ultimately render unnecessary all foreign importations of it—for the port of Plymouth, at least, and its neighbourhood.

"*Hemp*.—If hemp can be reared on the bogs of Russia, it is without doubt equally capable of cultivation on Dartmoor and Roborough Down."

Travelling Vehicles and Parcels are also included among the sources of income, as also is the *Transfer of Convicts to Dartmoor Prison*.

Such being the benefits which, in all good faith, were stated to

be derivable from the construction of this line, it is not surprising that the matter should have been taken up by a company, and accordingly we find a Plymouth paper indulging in the following somewhat high-flown language :

“The time is at length arrived so long, and yet whether in good report or evil report, so invariably anticipated by us, when the benefits of this measure are to be thrown open to the public. To Sir Thomas Tyrwhitt, as the original projector of this railway, and his able coadjutors in this port and other places, who have advanced cautiously but steadily to their object, may be assigned a praise which future generations will gratefully rejoice to perpetuate. It is not simply for themselves, but for posterity that they have devoted their time, their talent, and their capitals to the realization of a plan which not only reflects the greatest honour on the county of Devon, but will prove to the whole of this neighbourhood an inexhaustible source of advantage. Whether nationally or locally considered, it is a theme of proud congratulation. Whilst the region around, once apparently condemned to sterility, by the use of proper manures, will take its merited rank in British agriculture.”

Sir Thomas Tyrwhitt was an eminently practical and thorough-going man, but events have shown that his estimate of the agricultural value of Dartmoor was fortunately wrong. Although Plymouth has lost the valuable back-country promised her, and Dartmoor is still apparently condemned to what is called sterility, it must not be lost sight of that its value as an unenclosed space, where the public may trespass off the roads without being taken for amateur poachers, and where they can wander unfettered by hedges, or fear of damaging crops—its value, in fact, as a public park, similar to though smaller than the great American national parks, will grow and increase year by year ; while it is probable that as a sheep run and cattle pasture of the first order it is of much greater value than it ever could be as very inferior arable land.

A tender for the ironwork of the line was accepted on terms much below the estimate, and two hundred men were set to work quarrying and dressing granite on the moor, a lease of stone on Walkhampton Common having been granted by Sir M. M. Lopes.

The road as constructed consists of a single line only, and this doubtless accounts for the capital raised under the first Act, passed July 2nd, 1819, amounting only to £27,783, instead of £45,000, as estimated by Sir Thomas in his statement. On September 20th, 1819, the first general meeting of the proprietors took place, when a managing committee was elected : Mr. William Stuart, superintendent of the Plymouth Breakwater works, being

engineer; Mr. Hugh Mackintosh, of London, contractor for forming the road; and Messrs. Bailey and Co., also of London, contractors for the ironwork. It being found necessary to continue the line from Crabtree to Sutton Pool, so as to obtain better shipping facilities, an Act was passed (July 8th, 1820) authorizing this extension, the estimate for which amounted to £7200. A further Act was obtained (July 2nd, 1821) authorizing certain deviations, including a tunnel at Leigham, the estimated expenditure for the tunnel and other extra works being £5000. The total estimate was by these means brought up to £39,983.

The total length of line from Princetown to Sutton Pool is 25 m. 2 qr. 6 ch., of which in 1826 over 23 miles had been completed. In this year the contractors, both for road and ironwork, were Messrs. Johnson and Brice, of London, and Mr. Roger Hopkins had succeeded Mr. Stuart as engineer.¹

The tunnel at Leigham, in the twentieth mile from Princetown, is 620 yards long, 9 ft. 6 in. high, 8 ft. 6 in. broad, and its greatest depth below ground is 109 feet. It has no lining, but is left as cut through the rock.

The completed portion of the line was opened for public use on September 26th, 1823. I take the following description of the proceedings on that occasion from *The Telegraph and Chronicle*, under date Plymouth, Saturday, September 27th, 1823:

"Plymouth and Dartmoor Railway.—Our various readers, both local and distant, will learn with the sincerest pleasure that this great work, so long the object of our hopes and fears, and well designated by a worthy nobleman as the glory of the county, is now happily open for general trade. Yesterday was devoted to the celebration of the joyous event, and its festivities commenced with a public breakfast, liberally given by Sir Thomas Tyrwhitt, the original projector of the undertaking, at his Wharf on Roborough Down, where three marquees were erected, and every elegant species of viand provided for the reception and gratification of the company, which comprised much of the respectability and worth of the port and its neighbourhood.

¹ On the 13th of October of this same year an advertisement appeared in the *Plymouth Telegraph and Chronicle*, asking tenders for the excavating and completing of the tunnel at Leigham, and also the making of certain cuttings and embankments from thence to Crabtree and Sutton Harbour. Application to be made to Mr. Roger Hopkins, engineer and mineral surveyor, 6, Tavistock Street, Plymouth.

"The South Devon Band enlivened the scene with its choicest airs; but unhappily the weather was unfavourable, which drove many away ere the departure of the procession through the tunnel could be arranged. A long file of cars partly laden with granite, and partly with stewards and other individuals, accompanied by the band, and ornamented with flags, after the breakfast set off for Plymouth, on their arrival at which place they were heartily greeted by the huzzas of a large concourse of people, anxiously waiting their arrival, being saluted on their way by some petards at Hoo Meavy, and attended throughout the progress by a numerous cavalcade on horse and foot.

"About fifty gentlemen then sat down to a handsome dinner at the Royal Hotel, who did not separate until a late hour."

In the same paper are also notices of a last and final call of 10 per cent. per share, signed by William Burt, clerk to the Company, and also a notice of a general meeting of proprietors of the Plymouth and Dartmoor Company, signed: Morley, Masseh Lopes, Edmund Lockyer, William Elford, and John Pridham.

The line, as originally laid, consisted of parabolic edge-rails² set in cast-iron chairs, and these fastened down to stones averaging 2 ft. 6 in. long by 1 ft. 6 in. wide, and of varying depths. Some of these rails had lap-joints, and others butt-joints; two different forms of chairs being used to suit the different joints. The gauge of the line was 4 ft. 6 in.

Short sidings, and other portions not subjected to much wear, were laid in granite stones, averaging four feet long by one foot broad. These stones were arranged differently to those used at Heytor. The wheels ran on them precisely as on the iron rails, the inner edges of the granite being dressed to take them, and the outer portion of the stone being rough-picked to below the level of the dressed portion, forming in fact a granite in place of an iron rail.

The points and crossings were made in cast-iron, and the one feature noticeable is that the crossings had a movable tongue 1 ft. 5 in. long, similar to the points.

² With reference to these cast-iron edge-rails, I may mention as a curious fact, that in excavating in the fourth cylinder for the new Laira Bridge, on the Plymouth and Dartmoor Extension Railway, one of these rails was brought up from the bed of the Laira. The depth to which it had sunk below the surface of the mud could not be ascertained; but owing to the hard layer of clay and stones which Mr. Rendel placed over that portion of the river, it was probably lying very near the surface.

As the old rails wore out, and when the manufacture and use of rolled-iron rails became more general, these took the place of the old cast-iron edge-rail. They were used in lengths of from ten to eighteen feet, and being all flat-footed, were not secured to the stones by chairs, but were spiked down. The joints between two rails were made with a clasp, which gripped the flanges of both, the whole being usually secured to a stone. The rails were spiked to the same stones to which the original chairs had been fastened. Besides these, other stones were packed under the rails so as to, as far as possible, ensure a continuous solid bed. The rolled-rails were of various patterns; the four more especially used, shown in the diagram, being:—

1. An ordinary bridge rail weighing 45 lb. per yard. 2. A solid rail of similar form weighing 60 lb. per yard. 3. A Vignoles flange rail weighing $53\frac{1}{4}$ lb. per yard. 4. A similar but smaller rail weighing $38\frac{3}{8}$ lb. per yard.

The traffic over this line gradually decreased until 1880, when the portion between Princetown and the “Rock” was reconstructed for locomotive purposes, and a connection effected with the Great Western Railway at Yelverton.

The alterations were completed, and the railway opened, in August, 1883, the permanent way being the standard Great Western (narrow-gauge), of which a sketch is given for comparison with its predecessors.

REDRUTH AND CHACEWATER RAILWAY.

In 1824 the Redruth and Chacewater Railway Company was incorporated for making and maintaining a railway or tramroad from Redruth to Point Quay, with several branches therefrom; and also for restoring, improving, and maintaining the navigation of Restronguet Creek. The length of the main line was nine and a-quarter miles, and there were four branches, amounting together to about five miles. The capital was £22,500. This line was at one time laid with Barlow rails. A portion is now part of the West Cornwall line, the remainder is worked by a locomotive.

BODMIN AND WADEBRIDGE RAILWAY.

The Bodmin and Wadebridge Railway was first authorized by Act, dated 1832. It was the first line in the West on which steam-power was used, and was opened in 1834. The total length

is 14 m. 5 fur. 6 ch. In 1835 an amended Act was obtained; and in 1865 an Act for carrying out certain improvements, and among them apparently the substitution of heavier rails for those then existing. Very amusing stories are told of the harmless dangers and difficulties attendant on travelling by this, the third steam railway in the kingdom. (Some of these were narrated by the lecturer.)

The earliest permanent way consisted of wrought-iron rails of uniform single-headed section, weighing 37 lbs. per yard, and laid in chairs set on granite blocks placed 3 ft. 6 in., centre to centre. These granite blocks averaged 1 ft. 8 in. by 1 ft. 6 in. by 1 ft. deep, and the bed of the cast-iron chair measured 4 in. by 8 in. The rails were secured in the chairs by iron keys.

About 1864 these rails were partially replaced by others, weighing 56 lbs. per yard. The old permanent way was replaced in 1878-1879 by flanged Vignoles rails laid on wooden cross-sleepers, to which they were attached partly by spikes, and in parts by bolts and washers. Five miles of the way are now being taken up and relaid with the South-Western standard rails, and certain of the curves of somewhat small radius are being altered to meet modern requirements. Works are also in progress for connecting this portion with the new branch line to Bodmin from Bodmin Road, and thus with the Cornwall main line. The passenger traffic only ceased on October 30th, 1886, and the goods traffic continued up to September, 1887.

The earlier locomotives have for many years since been old iron; but a tender belonging, I believe, to the first locomotive, the *Camel*, is still to be seen at Wadebridge. A lithograph, published on the occasion of the opening of the railway on September 30th, 1834, shows the *Camel* with a train attached, containing 400 passengers. The same Roger Hopkins who was engineer to the Princetown railway seems, with his son, to have designed and superintended the Wadebridge line.

For some of my information concerning this railway I am indebted to Mr. Kidd, of Wadebridge, who very kindly answered my enquiries by giving me all the information in his power.

WEST CORNWALL RAILWAY.

The West Cornwall Railway, from Redruth to Hayle, was opened in 1835, and was worked by steam-power.

A railway from Hayle to Tresavean Mine was authorized in 1834, and powers of alteration given in 1836. This railway was at first worked by horse-power, but subsequently connected with the West Cornwall line under an Act of 1850.

THE TREFFRY RAILWAY.

Mr. J. T. Treffry, the proprietor of the port of Par, which port owed its existence to his enterprise, and who was also chief owner of the Fowey Consols and other mines in the district, formed a project to develop the resources of the neighbouring country by means of a tramway across Cornwall, from his port of Par on the south coast to his port of Newquay on the north. This railway was intended to open up the china-clay district, and to serve the granite quarries at Luxulyan, beside connecting the two coasts.

It is carried across the Rock Valley on the Treffry Viaduct, the foundation-stone of which was laid in March, 1839, and weighed ten tons. The viaduct was a little more than three years in building, the whole of this work being carried out by and at the sole expense of Mr. Treffry. The structure was made to serve the twofold purpose of a viaduct and an aqueduct. It consists of ten arches, each of 40 feet span, springing from piers 28 feet by 10 ft. 6 in. at the base. It is 650 feet in length, and 98 feet in height, and contains 200,000 cubic feet of granite. This is the oldest viaduct in the West of England now existing, and is at present utilised by the Cornwall Minerals Railway, which is formed on the basis of the original line.

With this we may be said to have reached the last of the early western railways, and to have traced the evolution of the permanent way down to modern times.

Since 1836 the principles of construction have remained practically the same, though the details have been subject to constant improvement. I have shown on the diagram the forms of rails in use in 1838, and on the other side of the sheet the result of fifty years' progress—whether the next fifty years will show an equal advance is open to great doubt; but let us hope that at least the shareholder in a modern railway may obtain a better return on his money than did his predecessors of half a century ago. They paid dearly for the experience which is ours to-day.

DESCRIPTION OF DIAGRAM.

THIS Diagram has been reduced by photography from the original, exhibited at the lecture, in which all the rail sections, with one exception, were drawn to their full size ; by this means accuracy has been ensured.

MORWELLHAM sections, left-hand top corner. The section on the left represents the rail now on the ground, and shews the method adopted for fastening to the chair by means of an iron key. The right-hand section has no claims to absolute accuracy, and is merely diagrammatic, intended to give some idea of the probable form of the earliest rail used on the incline.

WADEBRIDGE.—The first section on the left is that of the earliest form of rail used on this line, weight 37 lbs. per yard. The section to the right is that of the last rail of 1864, weight 56 lbs. per yard. The section in the centre is a Vignoles steel rail, weight 68 lbs. per yard, now replaced by South Western Railway standard-way.

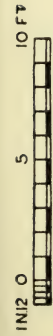
1838.—This portion of the diagram has been taken from Weale's *Public Works of Great Britain*, published in 1838. The first section in the top row on the left hand is that of the rail then in use on the *Manchester and Bolton Railway* ; the next to the right was in use on the *Croydon Railway* ; the next two were both used on the *Stanhope Railway* ; and the next two on the *Darlington*. The rail in the centre between the two rows was that in use on the *Great Western* ; and in the lower row running from left to right the rail sections are those of the following railways : *Whitby and Pickering*, *Greenwich*, *Clarence*, *Leeds and Selby*, *Manchester and Liverpool*, *Dublin and Kingstown*, *Newton and Warrington*, *London and Birmingham*.

1888.—Immediately opposite these, to the right, are figured some of the forms of rail now in use (1888), drawn to the same scale and in the following order : Left-hand top corner, *Princetown Railway*, 80 lbs. per yard ; *Pennsylvania U.S. Railroad* ; *Bodmin Railway*, 75 lbs. per yard ; and *Bristol and Exeter*, 74 lbs. per yard. Below these, the first section on the left is an intermediate *Great Western*, between that of 1838 and that of 1888, weighing 40 lbs. per yard. The adjoining section represents the modern *Great Western Railway* rail, weighing 68 lbs. per yard.

Plymouth and Dartmoor.—Commencing in the right-hand top corner of the diagram, the first detail given is a plan with elevation and section of the original cast-iron edge-rail, four feet long and six inches deep in the centre. This is the only section of rail on the diagram to which the Scale for Details in the right-hand top corner does not apply. Working downwards from left to right, the next sections in order are those of a rolled iron rail, weighing 60 lbs. per yard ; ditto weighing 45 lbs. per yard ; ditto weighing 53·25 lbs. per yard. A smaller one in the centre, between two sections of chairs, is also a rolled iron rail, weighing 38½ lbs. per yard.

Of the two chairs, of which sections and half plans are given, that to the left weighed 10 lbs., and was used for edge-rails with lap-joints ; that to the right weighed 13 lbs., and was used for another pattern of edge-rail with butt-joints.

In the centre of the diagram are two plans, the scale for which is in the left-hand corner. All that need be said with regard to the Heytor plan is that the hatched portion is meant to represent the raised half of the stone, and the plain portion the rebate, in which the wheels ran as indicated at A on the section. The plan of the Plymouth and Dartmoor Railway explains itself ; running off to the right at the top of the diagram is shewn the commencement of a granite siding.



SCALE FOR PLANS

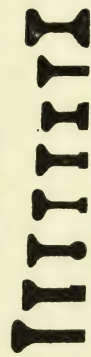
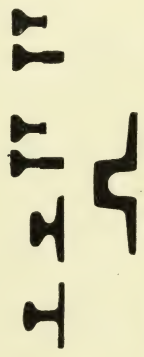


MORWELLHAM



WADEBRIDGE

1838

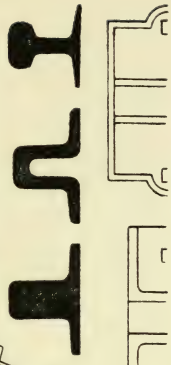


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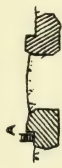
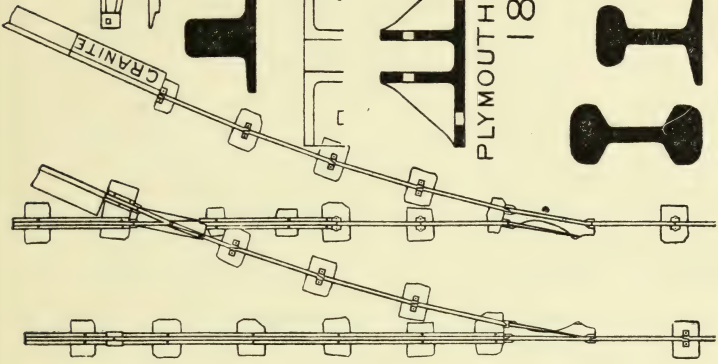
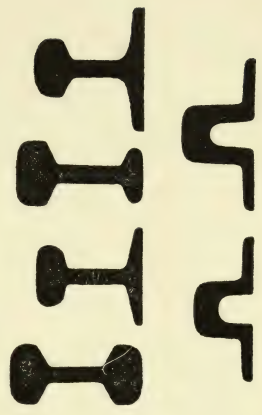


SCALE FOR DETAILS



PLYMOUTH AND DARTMOOR

1888



HEYTOR. P AND D.

DISCUSSION ON DARTMOOR

(CONTINUED).

W. GAGE TWEEDY, B.A., AND R. N. WORTH, F.G.S.

(15th March, 1888.)

MR. WORTH dwelt on the geology of Dartmoor. He described in succession the Archæan, the Silurian, and the Devonian seas, and next the Carboniferous. Dartmoor did not exist until all these eras had passed, because the rocks of which the moor was composed rose up through the Carboniferous. At the time Dartmoor originated there was a district composed of rocks of the periods mentioned, and in the centre there was a tremendous upheaval, the moor being now nothing more or less than the stump of a very considerable volcano which once reared itself high in the air. What had taken place since had been a steady reduction in the size and character of that mountain, which was going on perpetually, until its elevation was now half a mile; when at its highest it must have been at least two and a-half miles. The change in the heart of the rocks was best shown by the production of china clay; the great central change that had taken place in the mass of the granite of Dartmoor. Other changes arose from the upthrust and outburst of younger rocks, and the formation of mineral veins. Relative to visible changes, Mr. Worth remarked that those who knew the moor from year to year found points where changes were taking place—the rocks were weathering. The surface of the moor was covered in some places by loose stones, which were commonly associated with glacial boulders. But, unlike these, the Dartmoor blocks had not travelled very far, for, as a rule, they could find the parent rock not very far off. These “clitters,” as they were called, were, however, very gradually going down hill. Though it was now deficient in them, Devonshire had at one time many lakes. The site of the Head Weir was the bed of an old lake, formed by the Meavy, the

barrier of which was just below Sheepstor Bridge, where the rocks rose very high, and formed a kind of gorge. The processes that had resulted in degrading the volcano of Dartmoor from its original size to a stump would continue to go on until Dartmoor was brought down to the level of the sea.

Mr. TWEEDY remarked that the idea that Dartmoor once towered up above this country as a mountain 10,000 feet high was something startling. But if they considered the enormous deposits in all the estuaries around Devonshire they saw that something of that kind must have occurred to account for it. On the moor they were constantly coming across large masses of granite cleft in two; but if they examined them they found that there had been no real separation. The granite was lying on its original bed, and the separation was simply due to the slow crumbling away of the stone itself. In one instance this had apparently amounted to at least a foot in one great block, while if they looked at any of the crosses set up on the moor they saw the same thing. Hence it was that so few inscriptions could be found on the stones, and even those cut for Mr. Bray by a professional stonecutter were so crumbling and obliterated that it was impossible to make them out. Mr. Tweedy gave particulars of the number of mines formerly worked on Dartmoor. Was there any way, he asked, of accounting for the failure of mining except on the supposition that the tin found on the surface was the residue of the veins that were contained in the great pile two miles high that once existed on the spot?

ON THE TRACK OF THE "OLD MEN,"
DARTMOOR.

BY ROBERT BURNARD.

(Read 22nd March, 1888.)

A CASUAL observer on Dartmoor cannot fail to notice the disturbed state of the surfaces of the valleys ; for mile after mile the evidence of tin-streaming operations, consisting of mounds and old surface mining excavations, is plainly visible. A more careful examination discloses the remains of rude smelting huts, or blowing houses, containing stones with curious circular cavities, and ingot moulds hewn out of granite blocks, together with remains of furnaces, ancient watercourses, and wheel pits. Ask the moormen who made these things, and they will tell you that they are the "old men's workings," of a time so long since that none of them can give any clue as to the period when such remarkable evidence of centuries of work was accumulated.

It is popularly supposed that the Cassiterides included not only the Scilly Islands, but all the tin-producing portions of Devon and Cornwall ; and local writers, from Risdon downward, assert that the Phœnicians traded here for tin at a very early period. The principal authorities quoted in support of this statement are Strabo, the Greek geographer, Diodorus Siculus, and Velleius Paterculus, historians, who are all supposed to have flourished about two thousand years since. The story of the discovery of tin in this country is given as follows : The Phœnicians are stated to have had very early possession of tin mines in the south of Spain, near the Straits of Gibraltar, and also in what now constitutes the kingdom of Portugal. The colony of Gades—the modern Cadiz—is said to have been settled by them about 600 B.C. Extending around the coasts, the Phœnicians, on the exhaustion of the Spanish mines, discovered the metallic riches

of Devon and Cornwall, Risdon conjectures about the days of King David, and perhaps some centuries sooner. They are supposed to have kept the secret of the position of the Cassiterides to themselves for some two or three centuries, until the Romans, perfecting themselves in navigation, broke up the monopoly—Strabo says by dogging the Phœnician ships, and thus discovering the islands.

As these ancient writers narrated events which must have taken place some six hundred years before their time, the value of such statements is often questioned, especially as no single article of undoubted Phœnician manufacture has ever been discovered in this country. If Phœnicians ever came here they have left no tangible traces of their presence, and grave doubts are raised in some quarters as to whether they ever traded here at all. Professor Rhys is one of the doubters, and he places the tin islands in Vigo Bay, on the coast of Spain.

What is probably one of the most ancient blocks of tin in the world, is now in the Museum of the Royal Institution of Cornwall at Truro. It was dredged up about sixty-five years since near St. Mawes, at the entrance to Falmouth Harbour. An exhaustive description of this relic, by Colonel Sir Henry James, appears in the *Forty-fifth Annual Report of the Royal Institution of Cornwall*. This block is two feet eleven inches long, eleven inches wide, and three inches thick at the centre; perfectly flat on one side, but curved on the other, and having four prolongations at the corners, each one foot long. Diodorus describes the early tin ingots as being in the form of "astragali," and Professor Owen is quoted as the authority for the statement that this peculiar block is in the form of an astragalus, or knuckle bone. Sir Henry James very ingeniously accounts for the adoption of this shape by claiming for it a peculiar adaptability for stowage purposes in the bottom of a boat, and on a pack-saddle for land transport. No moulds of this form have as yet been discovered.

Camden says the Greeks traded with Britain, and fixes the period at one hundred and sixty years before Cæsar's invasion. Risdon is not so precise, but says no one doubts that they did trade here some time before the arrival of Julius Cæsar. In Cornwall, at any rate, there is no doubt that Roman influence was extended toward tin-mining; for, at Castle Zen, in the parish of

Veryan, a block of tin of a singular form was discovered with a Roman inscription on it. Borlase mentions Roman coins found in ancient stream workings at Wendron and Karn Brê; and from Fowey westward in all directions large quantities have from time to time been discovered.

The largest find mentioned is that of twenty-four gallons of Roman bronze coins, found during the spring of 1735, close to the Helford River.

We are informed that during the Saxon period the production of tin was neglected, but that the Romans worked the deposits to their great advantage. Lysons note that there is no mention of the Devonshire tin mines in *Domesday*. But this, as Rowe points out, can hardly be wondered at; for a tract of land like Dartmoor was, under no circumstances, likely to find its way into the *Domesday* enumeration; as the land intended to be included, and to which alone the description of *hides* and *carucates* can strictly apply, was land under tillage, or some other form of profitable management, yielding an annual revenue to its owner, and therefore the fit subject of a land-tax. Tin streams and mines appear to have been outside the *Domesday* scope. They contributed their share to the revenue of the king by means of rentals paid by the individuals who farmed them. In the Pipe Roll 8 Richard I. (1197), it is recorded that Master Philip de Haukechirche and Harveius de Helion render account of £100 from the farm of the Stannary of Devonshire, and of 100 marks (£66 13s. 4d.) from the farm of the Stannary of Cornwall for this year.

In 1250, King Henry III. granted a charter of protection to the tinnerns of Devon, commanding all knights and others, *of whom the tinnerns of Dartmoor held*, that they should not exact from them other customs and services than they ought, and had been accustomed to do, nor to vex them contrary to the liberties they had before enjoyed under charters of the king's predecessors, but maintain in the same liberties.

Matthew Paris says that this monarch extorted money from the Jews, and sold them in return for money advanced him by his brother Richard, Earl of Cornwall. The term "Jew's house," by which ancient smelting-houses are known in Cornwall, but not in Devon, has been supposed to indicate that the Jews were sent as slaves by Richard to work in the western mines; but, as Max Müller points out, there is no evidence in support of this, Jew's

house, like Marazion and "attall Saracen" being but a corruption of Cornish words.¹

Until the twelfth or thirteenth century European tin, unless any came from the East, must have been very largely and almost solely derived from this country, but about this period tin mines were discovered in Bohemia and Saxony. They do not appear to have seriously competed with the English mines; for between 1332 and 1345 it is recorded, in the accounts of the commercial industry of Florence, that the Italian merchants imported tin from Cornwall, from whence it was regularly conveyed in Italian vessels. It was exported from Cornwall in large slabs of a long square form, weighing about 200 lbs.

The streaming operations on Dartmoor must have been very active, and of an extensive character, from the thirteenth to the sixteenth centuries. Indeed, so active were they that Parliament had to interfere; and an Act was passed in 1531, having for its object the preservation of the havens of Plymouth, Dartmouth, and Fowey. The streamers were compelled to erect suitable catch-pits, for the purpose of arresting the silt, but it is very questionable whether the law was stringently applied; for, a few years after, Leland says that the Torey Brook ran red with sand from the tin works, and this had accumulated to such an extent as to choke up the lower and first buildings of the court of the Priory of Plympton Mary. Referring to Dartmouth he says, "The River of Darte by Tynne Workes carieth much

¹ In Appendix B to De La Beche's *Geological Report of Devon and Cornwall and West Somerset*, in the Red Book letter written about 1205 from William de Wrotham and others to the Archbishop of Canterbury, there occurs, in the enumeration of persons liable for penalties inflicted for contravention of the king's rules and regulations for refining, weighing, and stamping tin, the following expression, "Also neither man nor woman, Christian nor Jew," &c. The special mention of the Jews may indicate that they dealt in the metal, but it does not follow that they raised it. The selling referred to by Matthew Paris means that he pawned to his brother the legitimate and illegitimate taxes that could be squeezed out of the Hebrews. In the account given by Paris, who was a contemporary historian, there does not occur a single word which indicates that the Jews were sent as slaves into Cornwall to work the tin mines; on the contrary, he says, the "Earl spared them." If Jews did work the Cornish tin mines, it is fair to assume they worked in Devon as well, and seeing that they are supposed by some writers to have left their impress on one county, in the designation of the smelting-houses, it is strange they have left no impression whatever as the result of their labours in the other.

sand to Totenes Bridge, and chokith the Depth of the River downward, and doth much hurt to Dertmouth Haven." It is a pity Leland did not visit Dartmoor. He dismisses this region with the remark that "it is of a very great Compace, and is suche a wild Morisch and Forest Ground as Exmoor is."

This activity must have continued, but probably to a diminishing extent, through the seventeenth down to the early part of the eighteenth century, when Devonshire mining appears to have sunk into insignificance; and at the time Chapple wrote his *Review of Risdon*, in 1770, it hardly had an existence.

The visible tin-streaming remains on Dartmoor are mainly covered therefore by a period extending back from the beginning of this century to the year 1197, when Philip de Haukechirche and Harveius de Helion rendered account of rentals of the farms of the Stannaries of Devon and Cornwall.

Beyond this period, although there is no doubt of much more remote antiquity, the remains are uncertain. No discoveries in them of coins indicating much greater antiquity have been reported;² the whole subject appears to have been neglected; and the Dartmoor of to-day, although one of the most interesting spots in the British Isles, is also one of the least known and appreciated.

Dr. Evans approximates the commencement of the bronze age in Britain at from 3000 to 4000 years since. However this may be, tin was necessary to alloy the copper and harden it; and its production is as old on Dartmoor as the above estimate, and perhaps much older still.³

² A coin of Tiberius Constaninus (581) was, however, found at Prince Town in 1885.

³ An important discovery was made at Gittisham Hill, near Exeter, in 1869, which throws considerable light on the question of early bronze-founding in Britain. A barrow was opened before the members of the Devonshire Association, and in it were found four shapeless fragments of bronze, which appeared to have originally formed a portion of a cake of metal that had been melted in the saucer-shaped cavity of a stone, and which were obviously intended for casting purposes. They weighed respectively 10 ozs., $8\frac{1}{2}$ ozs., $5\frac{1}{2}$ ozs., and $1\frac{1}{2}$ ozs. Near Chudleigh two mould stones of green micaceous schist for a rapier-like dagger were unearthed; and in various parts of England, Scotland, and Ireland many mould stones for bronze castings have been discovered, and are now in various museums. At Lenant heavy lumps of fine copper were found with broken socketed celts; at Kenidjack Cliff, with palstaves and socketed celts; and at St. Hilary (all in Cornwall) lumps, weighing 14 or 15 lbs. each, were said

The following account of the mining operations of 300 years ago is abridged from Carew, the best authority we have on the subject. The discovery of the tin lodes, he says, is made by certain tin stones lying on the face of the ground. These are termed "shoad," as shed from the main lode. They are somewhat round, and smoothed by water action. "Where the finding of these affordeth a tempting likelihood, the Tynners goe to worke, casting up trenches before them, in depth five or six foote more or lesse, and three or foure in breadth, gathering up such shoad, as this turning of the earth doth offer to their sight."

The preparation of the ore is also completely described by this writer, both for lode and stream tin. In the former case, the largest stones were broken first with hammers, and then carried, either in waggons or on pack-horses, to a stamping-mill. This kind of mill is supposed to have been introduced about this period from Germany. It is described "as of great logges of timber, bound at the ends with yron, and lifted up and down by a wheele, driven with water." From the stamps it passed to the crazing-mill, consisting of two grinding-stones working one over the other, turned also with a water-wheel. The stamping-mill, as formerly introduced and used in connection with the crazing-mill, was evidently worked dry; for Carew says, "*Of late times* they mostly use wet stampers, and so have no need of the crazing mils for their best stuffe, but only for the crust of their tayles" (*i.e.* the coarser stuff in which the ore remained in the matrix—the "rows" of the modern miner). In stream works the stamps may have been unnecessary, as a crazing-mill would probably have been sufficient to break down the larger

to have been found with spear-heads. In a barrow on Mardon Hill, near Moretonhampstead, a spear-head of copper was found a few years since. (Spence Bate, "On Grimspound." *Trans. Plym. Inst.*, 1873.) Although there are no proofs of early copper-mining in Cornwall or Devon, there is good evidence that the Romans worked the Parys Mountain, Anglesea, for this metal, and it is likely that they followed in the footsteps of previous miners. If early copper-raising in Britain be disputed, the suggestion that tin was exchanged for copper cannot fairly be objected to. The earliest smelters of copper ran the metal into circular cakes, convex below and flat above, corresponding with the bronze cakes found near Exeter; whilst the castings found in Anglesea, with inscriptions in Roman characters, were of nearly even thickness, but with the edge inclined, as if they had been cast in a small frying-pan. The evidence gradually accumulating is strongly in favour of bronze-making in Celtic Britain before the advent of the Romans.

pebbles of tin stone met with in the stream work. After leaving the grinding machinery the stream of water was allowed to descend on a series of clods of turf, about three or four feet square, and one foot thick. On these the tinner spread a little of the ground ore, gently stirring it with his spade, so that the running water carried off the light earthy substances, leaving the heavier tin stuff on the turf. For further purification this was placed in a wooden dish or tub, described as broad, flat, and round, and about two feet in diameter, and having handles at the side. The tinner, sitting down, carefully rocked this vessel between his knees, gently pouring off from time to time the remnant of the lighter impurities. The residue was black tin.

In Carew's time two pounds of this smelted in the furnaces of the period yielded one pound of white or metallic tin. This was carried on in what were known as blowing-houses. The black tin, mixed with wood or peat charcoal, was reduced in a furnace, the heat of which was excited by means of bellows moved by a water-wheel. The tin was cast into ingots of about 250 or 300 lbs., which were slung over pack-horses, and taken at certain times to the nearest coinage town. There "the blocks or pieces of tin are brought into a great room ordained for that purpose, and there first peized or weighed, then tasted, that is proved whether they be soft tin or hard, and after marked with Her Majesty's stamp (Elizabeth). To the hard (less worth by 50 shillings in the thousand than the soft) the letter H is added ere it comes from the blowing-house. Each thousand must answer 40 shillings to the Queen, which with the other incident fees being satisfied, then, and not before, it is lawful for the owner to alienate and distract the same." The stamping and coining of the ingot rendered it saleable, heavy penalties being inflicted if tin was sold prior to coinage. The origin of this quality test is very ancient.⁴

The letter from William de Wrotham and others to the Archbishop of Canterbury, previously mentioned, exhibits the regulations in force respecting the tin coinage in Devon and Cornwall at the end of the twelfth or commencement of the thirteenth century. Reference is made to the admeasurement of the weights of the first and second smeltings, the stamping, and the disposition of the available profit of the king's tin.

It is difficult to understand what is meant by first and second

⁴ *Op. cit.* DE LA BECHE. Appendix B.

smeltings. When an ore is reduced to the metallic condition the operation is complete, and when conducted in a rude furnace contained doubtless a good deal of dirt and foreign matter. This impure ingot was weighed and stamped in the presence of the keepers and clerk on behalf of the king, and no one in or out of the Stannaries could have possession of any tin of the first *smelting* beyond a fortnight, unless this first stamping was complied with.

The ingots of this first stamping could not be kept beyond thirteen weeks without being taken to the nearest Stannary town appointed for the purpose, and there *melted* and refined (not smelted), freed from impurities, and receiving the stamp which certified as to its purity and fitness for sale.

The translation of this document in De la Beche constantly refers to the second *smelting*, but this second process obviously means *melting* and refining; for it is impossible to reconcile the very stringent rules and regulations of the first stamping, &c., with a crude mass of charcoal, unreduced black tin, and metal. It is stated that the refining of the tin shall be by weight of the city of Exeter; that is, as eight is to nine.

In other words, for every nine pounds of crude tin of the first stamping presented to the stannary refiner, eight pounds of pure tin, capable of taking the second stamp, must be returned to the owner.

In the Museum of this Institution there is an ancient tin ingot, holed for pack-saddle purposes, fourteen inches long, eight inches at the widest end, and seven inches at narrowest, and weighing fifty-two pounds. It does not correspond with the weight or shape of the ingots referred to as being exported to Italy in the earlier portion of the fourteenth century, and is possibly an ingot of early type lost or stolen on its way to the coinage town. It was found, with another precisely similar to it, whilst digging a drain at Slade, near Cornwood. These ingots may have been stolen or lost whilst on their way to Plympton, which was made a stannary town as early as 1328.

The laws guiding the tanners were comprehensive and, being framed by their own Parliament, were just and strictly administered in the interests of all concerned. The first Parliament of which we have any account met on Crockern Tor in 1494. The next of which we have details met in 1510. In Pearce's *Laws and*

Customs of the Stannaries in Devon, the names of the twenty-four "jurates," or delegates, attending this Parliament from each of the Stannary Courts of Chagford, Ashburton, Plympton, and Tavistock, are given. "Which said Jurates being sworn and try'd by the Assent and Consent of all the Tinnners in the County aforesaid, enact, ordain, and constitute, That every Statute of the Tinnners, afore this time then made, to be void, broken, and of none effect; and those done anew to be in this Court affirmed as hereafter followeth." The matter done anew consisted of thirty-seven clauses regulating the tinnners' conduct, protecting their interests, and providing for punishment in Lydford gaol.

Twenty-three years later there is an account of another Parliament, held for the purpose of confirming the rules and regulations of the previous one, and for passing new laws, consisting of sixteen clauses, the most important of which dealt with the fouling of the rivers, and consequent silting up of the havens of Dartmouth and Plymouth. This action was doubtless forced on the tinnners by the Act of Parliament passed two years before, to which reference has already been made. Courts were also held on the Tor in 1534, 1553, and in 1576.

The latter, held on the 6th of August in the sixteenth year of Elizabeth, was presided over by the Earl of Bedford, the Lord Warden of the Stannaries, and the first seven clauses of the thirty-eight enacted referred to the silting up of the havens. The penalties for carrying silt into the "main or great fresh rivers" were increased to forty marks (£26 13s. 4d.) or in default "to be committed to the prison of Lidforde, there to have the Imprisonment of one whole year, without Bail or Mainprise." No one was allowed to dig or work for tin within sixty feet of the rivers Teign, Dart, Plym, Tavy, Walkham, or Tamar. It was enacted that tinnners should have the right to carry their silt into any "hatches, tye-pitts, moory places, or *grounds which have been of ancient times wrought.*"

This convenient permit has doubtless buried up many an archæological treasure; for the earliest stream works have been covered by the later.

How long these open-air Parliaments had been held it is impossible to say. There is every indication that they were in existence long before 1494. The only records that would throw light on this and other interesting matters affecting Dartmoor, are concealed

from the enquiring mind at the Stannary Office. Applications for searching the documents stored there are refused.

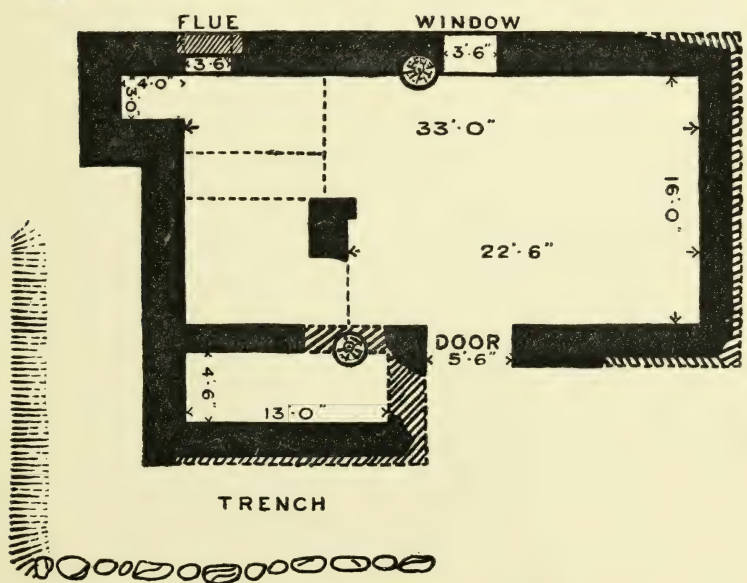
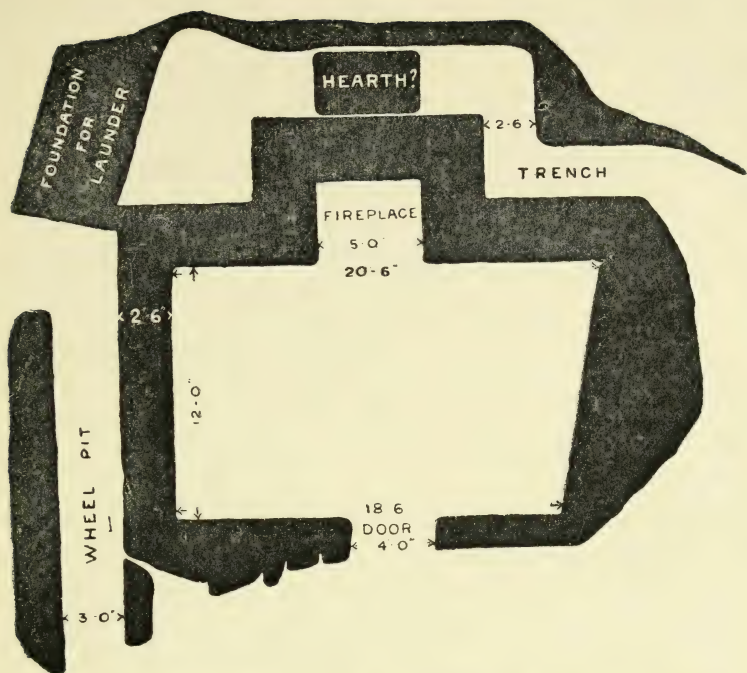
The examination of the ruins of the blowing-houses on Dartmoor is a most interesting study. Some appear to be similar in type, whilst others again are quite unlike. It is possible that the examination of a number of these ruins and their contents may throw considerable light on their probable age.

At present, my investigations extend over a few only of these remains, and this paper must be considered to be but of an introductory character to a large and important subject. No attempt will be made to come to hasty conclusions, but it is to be hoped that patient investigation will ultimately result in very much increasing our knowledge of these workings of the "old men."

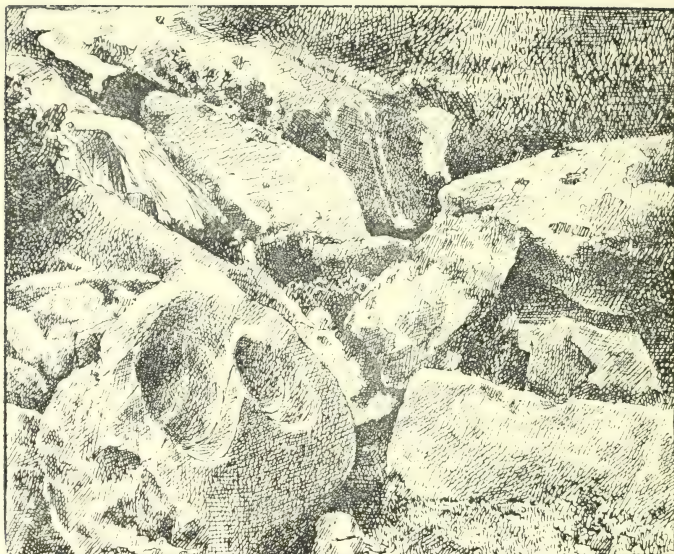
With the exception of two short papers by Mr. Thomas Kelly and Mr. Amery, and a few allusions by Mr. Spence Bate, no literature appears to exist on this subject, notwithstanding diligent search in quarters likely to contain the same.

I propose at first to describe two sets of ruins, one situated at Week Ford, Huccaby, and the other near Har Tor, Princetown. They are similar in construction. Each consists of two ruins; the blowing-house proper, and a habitation and possible storehouse, with a pit for an overshot water-wheel running the length of one side of this building. The water-wheel worked the bellows for the furnace, and might possibly have turned a crazing-mill, or worked rude stamps, but not to any great extent, as the wheels must have been of small size and power. The low and massive doorways are the same, and both have stones mixed up with the *débris*, containing curious circular or oval-shaped cavities, which may have been moulds, mortars, the bottom stones of primitive stamps, or the cavities formed by crazing-mill spindles, and answering to the same description as the foot-brass of the modern mill.

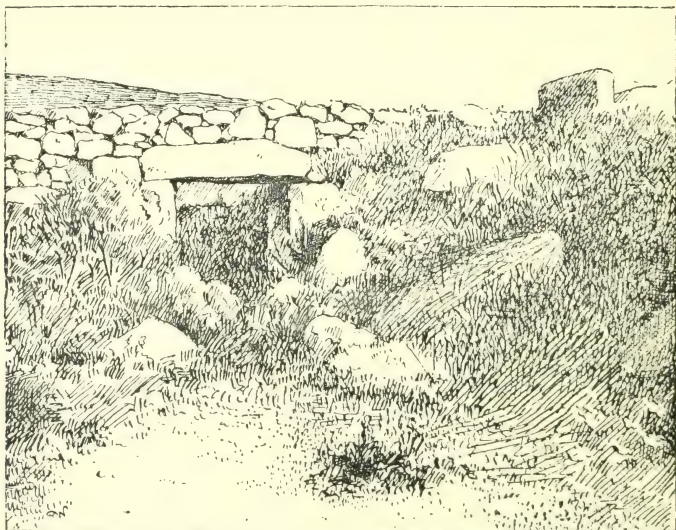
The Week Ford blowing-house, locally known as "Mill," is situated about fifty yards south-west of the junction of the West Dart with the Wobrook, or, as it was anciently called, the Okebrook, on the slope of the hill running up to Saddle Bridge. The ruin is in a most dilapidated condition, choked up with *débris* from the walls, and overgrown with vegetation. The



GROUND PLANS OF BLOWING-HOUSES AT WEEK FORD.



Stones with circular cavities on site of ruins of the western house
at Har Tor.



Entrance to the eastern Har Tor Blowing-house.

See page 106.

blowing-house is thirty-three feet long, sixteen feet wide, and is surrounded with an outer enclosure, or dwarf rampart, which was evidently intended to prevent surface water from gaining access to the furnaces.

The doorway, five feet six inches wide, is on the eastern side, with the jambs fairly perfect, but no lintel. It appears to have been about five feet high. Almost choking this up are two large stones, one containing three oval-shaped cavities, and the other two. These cavities are about seven inches wide, and vary from five to six inches deep. Opposite this entrance, and on the western side, is either a doorway or window, three feet wide with perfect jambs. This does not appear to be an entrance from the exterior, but leads—if a doorway—from the interior of the main building to an outside compartment of some depth, the bottom of which looks like the remnants of flues.

At the south end the walls of roughly-placed stones, some squared, with no sign of mortar, are five to six feet high, and in the centre of the house is what appears to be one side of a furnace mouth, formed of a wedge-shaped stone.

The most striking features of this ruin are two oak-trees; one with a trunk circumference of five feet six inches, growing inside the house, near the entrance on the eastern side, and the other with three boles, not so large, growing inside the ruin on the western side. In the south-west angle is the flue exit from furnace. Both are large and flourishing trees for Dartmoor, and must indicate considerable age.

Forty feet south of the blowing-house, higher up the hill, is the other ruin, eighteen feet six inches long by twelve feet wide. The doorway facing north has the jamb perfect on the western side, imperfect on the other, and was originally from three to four feet wide. The jamb has a groove about two feet long, three and a half inches wide, and about an inch deep. The footstone is in place at entrance.

The fireplace recess, two feet deep and four feet wide, with a portion of the chimney back standing, is on the south side of the building. What appears to be the hearth-stone has been removed, and is now lying on the high ground close behind the chimney. The walls of this house are three to four feet wide, and a portion of the western gable, seven to eight feet high, is still standing.

The wheel-pit runs the whole length of the eastern end of the

house, has an internal width of four feet, and is about six feet high. The northern end of the wheel-pit is open, and partly blocking it is a stone with three more of the oval cavities. Scattered about are stones containing fourteen of these cavities, and more are concealed under the *débris*.

The foundation of the launder carrying the water to the over-shot wheel is plainly visible, and here and there the leat supplying it can be traced up the valley to the river Wobrook.

About two hundred and fifty yards south of the ruins, and about fifty yards west of the Wobrook, is a hut circle twenty-seven feet in diameter. The foundations appear to be Celtic, but it has a comparatively-modern dry wall erection on it, some six to seven feet high, forming a rough gable, and was probably utilised as a residence by the tinnerns working at the stream works adjacent. Higher up the hill are ancient enclosures mapping out the slope in squares.

The Har Tor blowing-house is about two miles south-west of Princetown, on the head waters of the Meavy, close to the line of dam which would have formed the proposed Har Tor reservoir. The two ruins are situated on either side of the stream.

That on the western side is sixteen feet long by twelve feet wide. The chimney is still standing to the extent of six feet in height. The breastwork rests on a massive lintel of granite, the aperture being four feet square. Two stones, with two circular cavities six to seven inches in diameter and three inches deep, are lying among the *débris*. The walls, mostly in ruins, are composed of rough moorstones, dry laid; some are, however, shaped.

About fifty feet across the stream is the other ruin, twenty-two feet long and sixteen feet wide, with an entrance doorway on the south side three feet three inches wide and five feet high to lintel. This entrance is perfectly complete and intact. A part of the wall resting on the lintel is in good condition. The door-jamb and lintel are grooved and holed for door.

The wheel-pit, with a width of ten feet, is on the eastern side of the house. It is deeper than the floor of the building, and has on the northern side an outlet for allowing the water after use to return to the stream a few feet below it. It is difficult to trace the ingress; but as the bed of the river a few yards away is

higher than the point of entrance, a stream could easily have been led to the required direction and level. The eastern wall of the wheel-pit is built of very large stones, one being six feet long, four feet wide, and three feet deep, which must weigh some six or seven tons.

Inside the house, on the western side, is a recess ten feet long and four feet wide. At the entrance to this recess, in the south wall, just inside the doorway, is a small aperture or niche. On the eastern side, against the wall dividing the house from the wheel-pit, is the remnant of a fireplace.

No mould stones or circular cavities are visible.

The walls are built of similar stones to the other ruin, but are in a better condition, and much more perfect.

Numerous hut circles are dotted about the slopes in the vicinity. Two with avenues leading to them from the river are particularly fine, and in good preservation.

The whole valley has been disturbed to a great extent, showing that at some period the streaming operations here were of a very active character. The name of a neighbouring moorland farm (Stanlake) or the "tin stream" is very suggestive of this.

Gobbett mine, near Hexworthy, is a very interesting spot; for here are examples of the modern deep shaft, the shallow workings and deep open cuttings of the earlier miners, and the stream-works of the "old men." This, like nearly all the Dartmoor mines, is now abandoned.

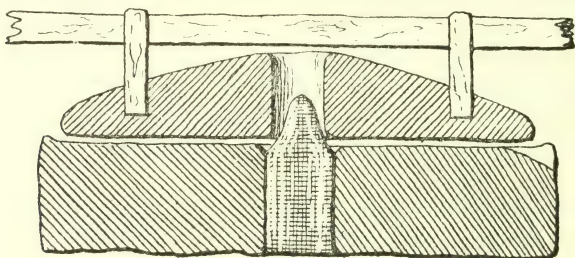
These remains of stream-works have been described by Mr. Amery in the *Transactions of the Devonshire Association* for 1870. Among them are the remains of a crazing-mill, consisting of the upper and the nether stone. The nether stone is three feet ten inches in diameter, and ten inches thick. The eye of the stone is circular, and has a diameter of six and a half inches. In the periphery is a groove, forming a lip, so that the ground material was readily discharged from the stone.

The upper stone is three feet in diameter on the flat grinding surface. The eye of this stone is five inches in diameter. The back is convex, roughly chipped and finished. The nether stone within the diameter of the upper is slightly worn by friction; but it is not concave, nor was the grinding surface of the upper stone the convex side, as described by Mr. Amery. The error of

this gentleman's description of the manner in which he supposed the stones worked is palpable on examination.

On the back, *i.e.* the convex side of the upper stone, are four holes, sunk from two to three inches, and about two inches in diameter, at equal distances from each other. Into these holes prongs were fitted which carried two bars, so that the stone was revolved by either horse- or man-power, similar to a capstan arrangement.

The hole or eye of the nether stone was for the purpose of receiving a conical plug, the apex of which penetrated partly up into the eye of the upper stone, and served the double purpose of keeping the runner stone in position, and distributing the feed equally on the grinding surfaces. To further assist this are four curved master furrows or grooves, radiating from the eye of the



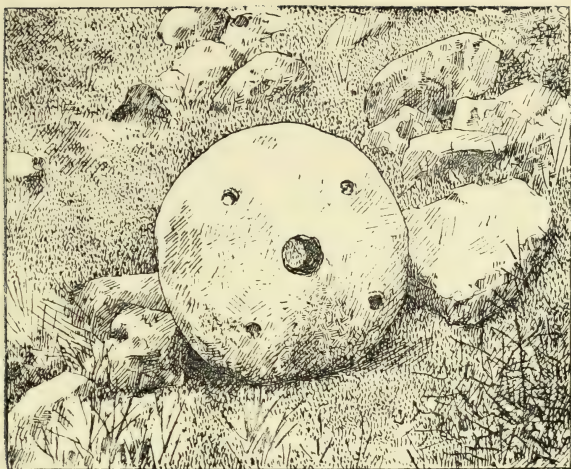
grinding-surface of the upper stone. The mill, worked by men or horses, was of slow speed, and water was introduced to assist the propulsion of the ground material towards the grooved lip in the periphery of the stone. This and the feed were of course introduced through the circular hole in the top stone.

The Roman hand-mill was of precisely similar type to this, only smaller, and worked by one perpendicular handle fixed in the runner.

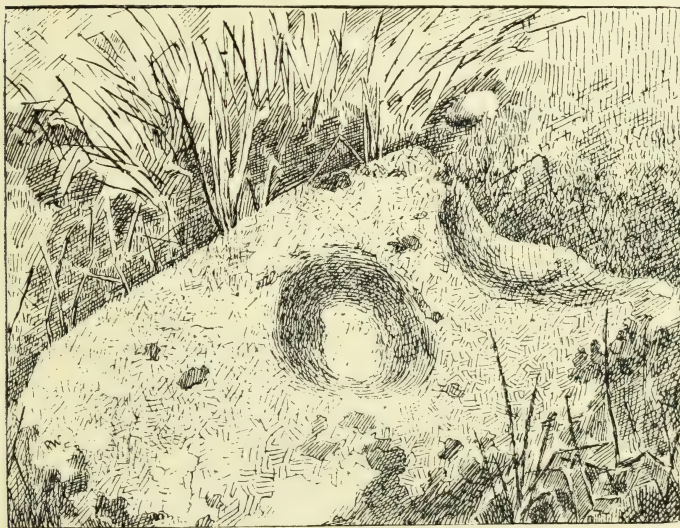
There are remains of two watercourses visible. One undoubtedly is modern, and the other may have been used by the streamers; but there are no traces of a wheel-pit, or anything to suggest water-power.

These remains of a crazing-mill are of the greatest interest, and of considerable antiquity. It is to be hoped that steps will soon be taken to ensure their safety.

On the site of what was evidently the blowing-house is a mould

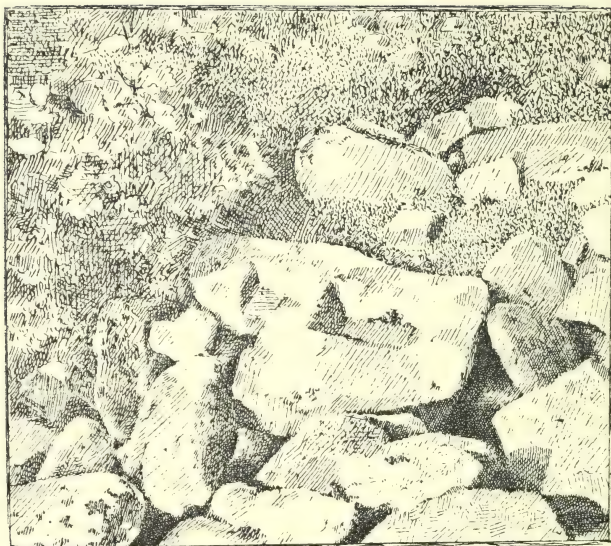


Back view of upper stone of remains of Craizing-mill at Gobbett.

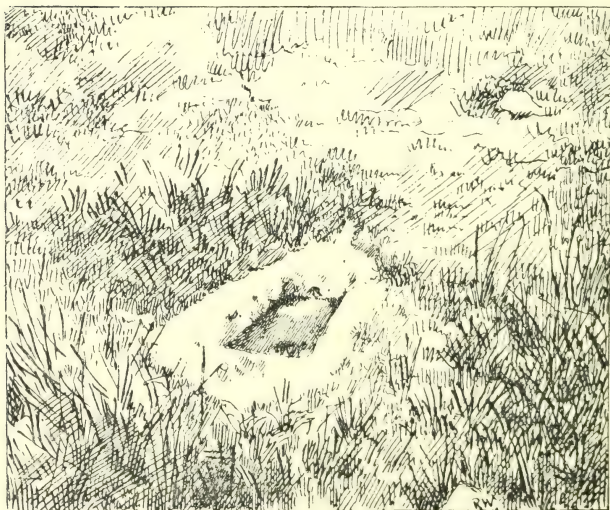


Oval-shaped cavities in stone at Gobbett.

See page 108.



Stone with bevelled moulds at the lower Blowing-house,
Yealm Head.



Mould stone outside Blowing-house at Deep Swincombe.

stone, about four feet by three feet. The mould is fifteen inches long, by eleven inches wide at one end and ten inches at the other, and four to five inches deep. There are also two small cavities two inches long, three wide, and two deep, between the mould and the edge of the stone, perhaps for receiving samples of the bulk of the metal in the large mould. So far I have not met with similar cavities elsewhere.

Another stone, not described by Mr. Amery, contains another cavity, which has the appearance of a receptacle for molten metal. It is seventeen inches long, ten wide at the narrowest end, and fifteen inches long at the widest end. At the narrowest end it is seven to eight inches deep, whilst at the widest end the depth is only three to four inches. Both these measurements of depth are increased to nine and ten inches in the centre of the cavity.

Several stones lying about have cavities in them similar to those found in other ruins, only instead of being circular they are more oval in shape, about eleven to twelve inches long, by seven to eight wide, and five deep.

Heaps of furnace slag, covered with soil and vegetation, occur just outside the site of the blowing-house. Flint chips, flakes, and scrapers, are to be found on Gobbett Hill near by, and although the formation of field walls has doubtless destroyed much of the pre-historic remains, there is sufficient evidence left to show that there were early inhabitants on this portion of the Moor.

About one mile and a half above the last waterfall in Hawns and Dendles, and near Yealm Head, on the eastern bank of the river, is the ruin of a blowing-house. A short distance beyond, but on the west bank, is another. Mr. Francis Brent first drew my attention to these remains; and I find they have been briefly described by Mr. Kelly in 1866 in the *Transactions of the Devonshire Association*, and in the same year in the *Journal of the Royal Institution of Cornwall*.

The title of each paper is, "Celtic Remains on Dartmoor," and the description of the ruins of rectangular buildings is associated with that of hut circles and other pre-historic British remains. Mr. Thomas Kelly gives illustrations of the mould stones in both these blowing-houses; and it is to be noted with

regret that the mould stone in the lower house has been broken since Mr. Kelly's visit, and that only one of the two moulds in the same stone is now intact.

I have made a careful examination of the present condition of these ruins with the following result: The lower house, on the eastern side of the stream, is a mere heap of stones, with portions only of the original structure standing. This building must have been about twenty-five to twenty-six feet long, and sixteen to seventeen feet wide.

The entrance, facing the north, is fairly perfect, with a doorpost of unhewn moorstone six feet high. This entrance is higher than those of Week Ford or Har Tor. No wheel-pit is visible, but there are traces of a watercourse at a high level to the north-east of the ruin. Near the entrance is a stone with one perfect mould and another imperfect. This is the stone which has been broken since Mr. Kelly's visit, somewhere about twenty-two years since. Originally it was four feet three inches long, two feet six inches wide, and about fifteen inches deep.

The perfect mould is seventeen inches long at the top, eleven inches wide, and eight inches deep. It is bevelled, so that at the bottom of the mould the length is twelve inches, and from six to seven inches wide. The length of this mould runs parallel with the length of the stone; whilst at right angles to it, and running the width of the stone, is the broken mould, which was originally of the same dimensions as the other.

Another mould stone lying near an angle in the eastern wall of the house either escaped the notice of Mr. Kelly, or else was not visible at the time of his visits. It is very curious, and differs from any I have yet seen. The stone is three feet six inches long and three feet wide; the depth not ascertained, as it is buried up in *débris*. It has two moulds adjoining each other—one at a lower level than the other, and connected by a channel. The high-level cavity is fifteen inches long, eight inches wide, and three inches deep. At one end is a groove an inch deep, perpendicular, and running down the side of the mould three inches; that is, from top to bottom.

The low-level mould is seventeen inches long, twelve inches wide, and five inches deep. These cavities may have been used for the purification of the tin, for molten metal mixed with furnace impurities poured in on the high-level hollow would

flow in a purer condition into the low-level mould, which is almost of the identical size as the moulds previously described.

About a quarter of a mile further up the river, but on the western bank, is the other ruin, with an internal length of twenty-eight and a half feet by ten feet wide. The doorway, which is very imperfect, is on the eastern side, and is three feet nine inches wide. At the south extremity the wall is fairly perfect; and at this end is a recess six feet long by three feet wide, similar, but smaller, to the recess already described in one of the ruins near Har Tor. There is one stone visible (two feet eight inches long by two feet four inches wide), containing a mould seventeen inches long, twelve inches wide, and from four to five inches deep.

Mr. Thomas Kelly mentions another stone outside the hut with a similar mould, but so far I have been unable to find it. Close by is a British village with two large enclosures, and from forty to fifty hut circles. The foundations of some of these are in a fine state of preservation.

The whole of the valleys have been turned over in streaming; the usual mounds and heaps of *débris*, some neatly walled-up with dry work, abound.

Excepting the two blowing-houses and the hut circles, no traces of habitations exist. The tinnerns probably utilised the foundations of their British ancestors for their dwellings. This is borne out by the apparently comparative modern remains on the hut circle above Week Ford, and on another circle, mentioned hereafter, at Deep Swincombe.

The other blowing-house left for description within the scope of this paper is probably the most ancient and primitive of any of the rectangular ruins I have yet visited.

It is situated in a valley washed by a small tributary stream of the river Swincombe, running about south from Swincombe Farm. The valley is known as Deep Swincombe, and the whole of it has been extensively streambed for tin. The blowing-house, or what remains of it, is concealed in a mound. It is twenty feet long by thirteen feet wide, the internal dimensions narrowing somewhat toward the south-west. The walls are thick, and built of stones dry laid, some being roughly-shaped. At this end, concealed by vegetation, is a chamber, completely enclosed and covered, six feet long, four feet wide, and about the same in height. The

back of this chamber is built with fairly-placed hewn stones ; the front wall is composed of smaller stones, more roughly placed together, whilst the roof is formed of hewn cover stones, buried in soil and vegetation. The bottom of this chamber is peat soil, with no paving. The internal stones appear to have been subject to the action of fire, and in the crevices between them I collected some fine dust, which still shows traces, on examination, of tin and lead. The black mould in the bottom has been thoroughly examined, but no trace of fused metal was discovered.

The western end of this chamber communicates through a flue, with a recess in this corner, and was evidently some portion of the furnace arrangement. No outlet is visible on the eastern side. There are no water-power remains.

On the eastern side of the house, and distant about six feet, is a curious mould, hollowed out of a rock which slightly protrudes above the surface. It is twenty-six inches long, and twelve inches wide by five inches deep at one end ; whilst it is fifteen inches wide, and two inches deep, at the other. The rock in which this mould is cut inclines from the deeper to the shallower end, so that when filled with metal the ingot would start with being two inches thick at the wider end, decreasing in thickness until it reached the narrow, or upper end, when it would run out to a thin cake. I have hitherto seen no other mould of this shape and dimensions.

About two to three hundred yards north of this blowing-house, and on the slope of the hill facing the valley of the Swincombe, is a large hut-circle, twenty-four feet in diameter, having on it a wall rising to a height of four to five feet, similar to the hut circle above Week Ford.

Further up the gorge, beyond the blowing-house, is a large granite boulder, one end of which is resting on a sloping piece of ground, and the other on a dwarf wall, so that the height of the space covered and enclosed is two feet.

There is room for three or four men to crawl in and lie down, and thinking it may have been used as a sort of lair, I excavated about a foot of the floor, and carefully sifted the same. No traces of human habitation were found, and I therefore consider this curious primitive-looking cavity to be a *cache*, or hiding-place, either for metal or tools. A few lumps of turf would most effectually conceal the entrance and defy even a close search.

RECENT GEOLOGICAL WORK AT THE LIZARD.

ABSTRACT OF LECTURE BY HOWARD FOX, F.G.S.

(Read 29th March, 1888.)

THE Lecturer commenced by assuming that his audience were accompanying him along the coast of the Lizard district in small boats, and thereby able to land and examine various junctions and sections of interest which could only be reached by water. Beginning at the Polurian Cove junction of the Silurian slates with the massive hornblendic schists on the west coast, the party were supposed to row round the Lizard to the other coast junction of slates and schists immediately east of Porthallow, in Falmouth Bay. A series of the 25-inch parish maps, coloured geologically by the lecturer, enabled him to point out the most interesting spots, and to indicate where exposures of various rocks not hitherto recorded might be seen.

The Parc Bean serpentine extended 300 yards inland, and 150 yards along the foreshore. It was 500 yards south-west of Lower Pradanack farmhouse. On the cliff above the cave junction of the schist and serpentine at Ogo Dour (Ugethawr) a band of limestone was found weathering in ridges. At Vellan Head several dykes were seen traversing the serpentine cliffs, and causing much disintegration, often accompanied by banded series of quartzose, crypto-crystalline, and serpentinous rocks of various colours, from light green to bright brick-red. Some of the dykes were porphyritic. Passing the fine serpentine arch to the north of the "Horse" promontory, reference was made to the schist found between the Rill Head and Rill Ledges. Macroscopically, this resembled mica-schist, but was in reality a tremolite-schist. The gabbro vein east of Kynance Cove, with its accompanying mass of saussuritic rock, was described, and the arch and cave adjoining, which could only be seen from the water. Immediately east of the Lion Rock banded crystalline rocks, similar in

constitution to Professor Bonney's "granulitic group," could be seen cutting the serpentine—the granitic bands often weathering red, and the basic bands being more or less porphyritic. A more extensive exposure of the same rock was to be seen still further east, below Holestrow, north of Pentreath Beach. On the west side of Lizard Head a banded granulitic rock, of yellowish-white colour, traversed the dark schistose cliff in a winding manner, resembling a serpent 100 yards long, with its head at the water's edge, and its tail near the top of the cliff. When the light shone favourably the resemblance extended to the scales on the head, and even to the well-marked eyes.

The gneissic outlying rocks, with their porphyritic basic dykes, were next described. Mr. Teall considered these rocks analogous to those of the Scourie dyke region in Sutherlandshire. The coarser gneisses were found most to seaward, and the rocks became finer and more granulitic as they approached the mainland. Many appeared to be transitional between typical gneisses and granulites, and the micaceous, actinolitic, and hornblendic schists of the mainland.

Proceeding east, several exposures of micaceous schist were seen on both sides of Penolver Head, and the west side of Bass Point. These could be best examined in the small cove between these points. This cove was called Treerobin on the 1-inch ordnance map, Polledan on the 25-inch parish map, and was locally known as Belidden. The cove was due to the disintegration of the rock, consequent on a fault which caused the rocks on the west side to dip south of west, whilst those on the east side, in conformity with the general divisional planes of the district, dipped north of east. Penolver Head was marked by a broad band of epidote, conspicuous, when seen from a boat, by its light green colour. Both Penolver and Bass Points were composed of dark hornblende beautifully banded with epidote and felspar, and the former showed porphyritic crystals in some of the hornblendic bands.

Pen Vose, or Parn Voose, north of Church Cove, had been fully described by Professor Bonney and Mr. Teall. It was within ten minutes' walk of Landewednack Church, and should be visited by everyone interested in geology. Fine and coarse, massive and schistose gabbros, porphyritic diorites, serpentine and banded crystalline rocks, with a granitic vein, were there found

within a few yards in most intricate order. East of Caerleon Cove the foreshore was thickly strewn with boulders of serpentine and banded crystalline rocks, amongst which were many showing crystals of white or pink felspar in their dark hornblendic ground mass. The crystals varied in size, from 5×3 inches to some less than $\frac{1}{4}$ inch long, and studded some boulders so thickly as to resemble mosaic. The parent rock was found *in situ* on the foreshore and running up the cliff, and was a diorite.

East of Kennack Beach were two extensive exposures of granitic rock, conspicuous from a boat by a bright rust colour they gave to the cliffs. Among the schistose and ribboned gabbros, west of Spernic arch, were basic bands of porphyritic rocks. At Downas Cove, at the north-east end of Kennack Bay, basic dykes, and fine and coarse gabbros were found, with a granulitic gabbro composed of felspar and colourless pyroxene. Throughout the region between Kennack and Downas Cove, a light greenish-grey serpentine at times traversed the dark red serpentine in the manner of dykes, and contained crystals of picotite. These were seen best at Lankidden Cove, and at Butter Cove, a little west of Downas Cove. In the latter exposure the dyke was more disintegrated and jointed out of the cliff, and each crystal of the resinous-looking picotite was surrounded by a border of lighter colour than the main mass.

The junctions at Coverack were numerous and interesting, and the olivine-gabbros exported thence for metalling roads, made splendid sections for the microscope. After passing the uralitic gabbros of the Manacle rocks, and the hornblendic gneiss of the Drawna rock district, the trip was supposed to end at Porthallow, where the junction of the slates and schists was so disorderd, and covered with so much *débris*, as to give rise to much difference of opinion amongst geologists, both as to their origin and actual mode of occurrence.

The lecturer dwelt on the changes constantly occurring on the coast from falling cliffs, and on the difficulty experienced in examining some foreshore sections from the mass of sand, shingle, and seaweed, at times thrown up by the sea.

The various theories of the leading geologists were then referred to at length.

Seventy years ago Professor Sedgwick, as the result of a careful survey of the district, wrote: "We were led to conclude that

the great plateau of the Lizard was not composed of stratified rocks."

Sir Henry De la Beche, fifty years ago, summed up as follows : "As a whole, however, the hornblende slate and rock seem to have formed a basin into which the serpentine and diallage rock have been poured in a state of fusion."

For nearly forty years after De la Beche's *Report*, little further light was cast on this interesting series of metamorphic rocks, until Professor Bonney published his paper on "The Serpentine and Associated Rocks of the Lizard District," in the *Quarterly Journal of the Geological Society*, in 1877. This was followed by a second paper on "The Hornblendic and Other Schists of the Lizard District, with some Additional Notes on the Serpentine," published in the same journal in 1883. These papers marked a new departure in the history of the investigation. They treated minutely of the various junctions between Polurrian on the west coast, and Porthallow on the east coast, and the macroscopical and microscopical description and chemical composition of the rocks were given.

Professor Bonney's observations led him to conclude that—

1. The serpentine of the Lizard was originally an intrusive rock.
2. Its intrusion was posterior to the metamorphism of the hornblende schist.
3. The serpentine had been broken through by several granite dykes, by gabbros of two dates, and by dark trap dykes.
4. The gabbros were liable to three forms of mineral change ; (a) a gradual conversion of felspar into a micro-crystalline saussuritic mineral ; (b) conversion of their diallage into hornblende by pseudomorphism or re-crystallization, some olivine disappearing in the process ; (c) conversion of the olivine into serpentine.
5. The trap dykes were probably all once dolerites, or basalts, and the hornblende was due to the metamorphism of the original pyroxenic constituent.
6. The metamorphism of the serpentine was probably complete before the intrusion of the above rocks.
7. The serpentinous aspect of a rock was often illusory, and due to the presence of extremely small proportions of that mineral.
8. In addition to the talco-micaceous and hornblende-schist

group already recognised, there was a third, or granulitic group, occurring between the Balk Quarry and Kennack Beach.

9. These groups formed but one series, enumerated in ascending order. 1. Characterised by dull green schists, and by brown mica schists. 2. By black lustrous hornblende-schists, sometimes rather massive, sometimes beautifully banded with felspar or epidote. 3. By pinkish-grey quartz-felspar rock, closely inter-banded with dark hornblendic or micaceous layers.

10. The schists were all Archæan.

These conclusions Professor Bonney still held, subject to some slight modifications. In a letter which appeared in the *Geological Magazine* for December, 1887, he wrote: "I admit, however, that when I wrote my two papers I sometimes failed to distinguish between the structure significant of original constitution, and those due to subsequent mechanical action, for our knowledge of the latter is of very recent date; but to what extent I will not venture to say, until I can again examine the whole district."

Mr. J. H. Collins, in a paper on "The Serpentine and Associated Rocks of Porthalla Cove," published in the *Quarterly Journal* in 1884, challenged Professor Bonney's views as to the origin and order of the rocks in that district. He writes: "While I do not deny that in some instances even in the Lizard district masses of highly-basic and distinctly-intrusive igneous rocks may have been altered into serpentine, yet in this case (Porthalla) the evidence is altogether the other way. Careful examination of the cliff sections affords evidence of stratification in the serpentine, both on the large and on the small scale (*i.e.* of the serpentinous change of stratified materials *in situ*). This conclusion is supported by the chemical analysis of hand specimens, as well as by their macroscopical and microscopical appearance. Finally, I cannot see any sufficient reason for referring these metamorphosed rocks to any Archæan series. . . . I believe, in short, that the Lizard rocks may be Archæan, but that those of Porthalla are of much later origin, and most probably Lower Silurian."

In reply to a letter from Mr. Alexander Somervail, of Torquay, supporting Professor Bonney's views, Mr. Collins wrote, in the *Geological Magazine* for July, 1885, "What I believe is, not that the 'slate' has been altered into serpentine, but that of an originally differing series of conformable bedded rocks some beds have been converted into that peculiar variety of hornblendic

schist which characterises the locality, others have been converted into true serpentine, and others again into a rock of intermediate character."

Mr. Collins reiterated his views in a continuation of the paper published in the *Geological Magazine* for August, 1886.

During the summer of 1886, Mr. J. J. H. Teall, author of *British Petrography*, spent many weeks at the Lizard examining and photographing the junctions and rocks of that district. The *Geological Magazine* for November of that year, contained a paper by him on "The Lizard Gabbros," with a beautifully worked plate representing the schistose augen-gabbro of Karakclews in Kennack Bay. He contended in this paper that the foliated structure in the gabbros is "a secondary structure, due to earth-movements acting upon the solid rock," and is the "result of pressure, or regional, metamorphism." He considered "that the replacement of felspar and diallage by saussurite and hornblende, has been largely determined by the same agency." He read a paper on "The Metamorphosis of Basic Igneous Rocks" before the Geological Association in April, 1887, and a paper on "The Origin of Banded Gneisses" at the British Association in September, 1887. In both of these papers he referred to the Lizard rocks. In the former he writes: "The south-western portion of the Lizard district is a region of intense mechanical metamorphism. The structural characters of the rocks are similar in many respects to those which may be observed along the great line of disturbance on the north-west of Scotland;" and after referring to Dr. Lehmann's work on "The Origin of Crystalline Schists," he said, "Must we regard all hornblende-schists as the result of regional metamorphism operating upon basic igneous rocks? So far as these questions are concerned I will confess at once that I have not made up my mind." The latter paper, which appeared in the *Geological Magazine* for November, 1887, and was accompanied by maps, photographs, and diagrams, concluded with the conviction "that a banded structure in rocks (as in the Lizard 'granulitic group') having the composition of igneous rocks, was no proof that the latter were not of igneous origin."

With reference to the outlying Lizard rocks he writes: "According to my views, the rocks of the Lizard Head are structurally the equivalents of the schists which occur immediately east of the great plain of disturbance in Sutherland. . . . I doubt very

much whether there is any stratification, in the ordinary sense of the word, in the Lizard peninsula."

Colonel McMahon, of London, published a paper on "The Lizard Gabbros" in the *Geological Magazine* for February, 1887, and he is still working on the subject. He suggested a modification of Mr. Teall's view as to the cause of the foliation in the gabbros, thinking it produced by "shearing motion" in the rock after its consolidation had advanced considerably, but was still incomplete, and not by "earth-movements acting upon the *solid* rock."

A paper on the "Occurrence of Porphyritic Structure in the Lizard Rocks," by Mr. Alexander Somervail and the lecturer, was read before the British Association in 1887, and appeared in the *Geological Magazine* for February, 1888. They were led to the conclusion that many of the rocks hitherto known as schists were of igneous origin.

The work of German geologists was appealed to by Mr. Teall in support of his views. Professor Bonney, whilst acknowledging that English geologists formerly underrated the effects of "squash," considered the tendency now was to attribute too much to that agency.

Mr. Teall's latest confession of faith was as follows: "I believe the granulitic series of Professor Bonney is an igneous complex; that the south-west portion of the Lizard is a zone of intense dynamic metamorphism, in which basic dykes have been transformed into actinolitic schists; that gabbros and serpentines have been foliated by dynamic metamorphism in various parts of the district: but I am quite unable to frame any general theory which will satisfactorily account for all the phenomena. I regard the origin of the hornblende-schists as one of the most important unsolved problems."

BALÆNOPTERA ROSTRATA.

BY F. H. BALKWILL, L.D.S.

(Read 5th April, 1888.)

ON May 16th, 1887, a fisherman reported that one of the trawlers had taken "an enormous fish with its mouth full of hair." Concluding that his description indicated a young whale-bone whale of some species, I proceeded to the Barbican, and found the animal lying on the deck of the Lowestoft fishing-smack *Bluebell*. It proved to be a young female Lesser Rorqual (*Balænoptera rostrata*), which had been captured, rolled up in a drift-net, sixty miles south-west of the Scilly Isles. It was in perfect condition, the glistening white of the belly and plicæ being quite beautiful.

The animal was exhibited about the town for a day or two on a pony-cart, when I acquired the head, in order to make a skull for our Museum. The following are the dimensions :

BALÆNOPTERA ROSTRATA (YOUNG FEMALE).

	ft.	in.
Entire length, following curve of body . . .	12	7½
Length of gape . . .	3	1
Width across lower jaw . . .	1	9½
Length of eye, which was at angle of mouth . . .	0	3½
Length from point of snout to insertion of flipper . . .	3	4
Length of flipper . . .	1	10
Width of flipper . . .	0	6
Length from point of snout to dorsal fin . . .	6	4
Height of dorsal fin . . .	0	8
Width of dorsal fin . . .	0	8
Width of caudal fin . . .	3	1
Length from point of snout to blowholes . . .	1	8
Length of blowholes, which were two longitudinal slits close together each side of median line . . .	0	4

The flippers had the white transverse band characteristic of this species. Weight estimated about 15 cwt. The skull, which is nearly finished, I am preparing for the Museum.¹

¹ Where it is now placed.

The following are some of its dimensions :

SKULL OF BALÆOPTERA ROSTRATA.				ft.	in.
Length in straight line	.	.	.	3	0
Greatest width across squamosals	.	.	.	1	4
Length of lower jaw in straight line	.	.	.	2	$8\frac{5}{8}$
Width of lower jaw	.	.	.	1	7
Length of superior maxillary bones	.	.	.	1	$11\frac{1}{2}$
Length of intermaxillary bones	.	.	.	1	11
Length of nasal bones	.	.	.	0	$2\frac{7}{8}$

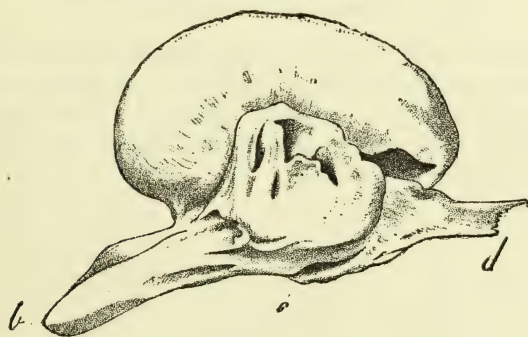
All the bones of the skull were arranged symmetrically on each side of the median line.

Longest blade of whalebone, which was of a light horn colour 0 4 $\frac{5}{8}$

ATLAS.				ft.	in.
Height	.	.	.	0	$5\frac{4}{8}$
Width	.	.	.	0	$7\frac{2}{8}$
Height of neural and axial foramen	.	.	.	0	$3\frac{3}{8}$
Width of neural and axial foramen	.	.	.	0	$2\frac{3}{8}$

AXIS.				ft.	in.
Height	.	.	.	0	$5\frac{3}{8}$
Width	.	.	.	0	$8\frac{3}{8}$
Width of body	.	.	.	0	5
Height of body	.	.	.	0	$2\frac{4}{8}$

I had some difficulty in defining the relations of the Atlas and Axis, which Professor Flower, of the British Museum, cleared up for me with great readiness and courtesy.



EAR-BONES OF LESSER RORQUAL.

(*Balæoptera Rostrata*.)

a Tympanic bone, extreme width 3 in.

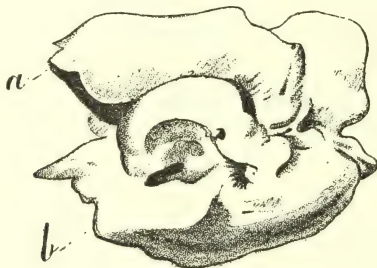
b Zygomatic process. *c* Periotic Bone. *d* Pterygoid process.

Extreme width from *b* to *d* 5 in.

Some interest attaches to the ear-bones among Cetacea. According to the late Dr. Gray, they are at least of generic value. I therefore give drawings of the ear-bone of the present example, and also that of the Risso's Grampus, recorded last year.

In the Lesser Rorqual the Tympanic and Periotic bones are attached to each other, and from the latter are extended two large Zygomatic and Pterygoid processes.

In the ear-bone of Risso's Grampus the Tympanic and Periotic bones are nearly equal in size—about an inch and a half in greatest diameter—and the articulating processes are only just indicated.



EAR-BONES OF RISSO'S GRAMPUS.

(*Grampus Griseus*.)

a Tympanic bone.

b Periotic bone.

Greatest width about $1\frac{1}{2}$ in.

In conclusion, I would point out that the experience of the past three years shows that our fauna is much richer in Cetacea than might have been expected, and that our Museum might be enriched with many valuable skeletons if we had a tank suitable for their preparation.



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